THE JOURNAL OF MICROSCOPY AND NATURAL SCIENCE:

THE JOURNAL OF

THE POSTAL MICROSCOPICAL SOCIETY.

EDITED BY

ALFRED ALLEN,

Honorary Secretary of the Postal Microscopical Society.

ASSISTED BY

SEVERAL MEMBERS OF THE COMMITTEE.

VOL. III.

London:

W. P. COLLINS, 157, GREAT PORTLAND STREET.

Bath:

1, CAMBRIDGE PLACE.

1884.

Preface.

THE present issue is the Third Volume of our Journal which we send forth to the world, assured that it will receive the same welcome in the homes of Scientific men, both English and Foreign, which has been accorded to the previous volumes.

The completion of the third year of the existence of any Scientific Journal, is, in many respects, a season for much congratulation, for it not only marks a successful passage through the many, and in most cases, inevitable difficulties which beset the infancy of publication, but at the same time, the character of the work becomes increasingly more decided and apparent.

The change of title adopted with the present Volume, has allowed us somewhat to diverge from the paths of pure and simple Microscopy; whilst at the same time, no article has been inserted that has not come fully within our present sphere; and we may now hope that the merits of the "Journal of Microscopy and Natural Science" are fully established before the public, and that an abundant success will speedily reward our labours.

We wish to add that no pains will be spared in the future to make this Journal worthy of its name, and of the Society which it represents, and that the variety and interest of its articles will add much to its attraction and usefulness.

It is hoped, too, that by this periodical, the advantages of the "Postal Microscopical Society," to which the Journal owes its origin, will become now generally known, and that the members of the parent society will endeavour to insert such notes and drawings in the note-books, as will be worthy of publication.

The Editor desires to thank those who have so kindly contributed articles, and to solicit from them and other friends, further papers upon any scientific subject of interest.

THE JOURNAL OF MICROSCOPY

AND

NATURAL SCIENCE:

THE JOURNAL OF

THE POSTAL MICROSCOPICAL SOCIETY.

JANUARY, 1884.

The Address of the President of the Postal Microscopical Society,

CAREY P. COOMBS, M.D., AT THE ANNUAL MEETING,
OCT. 11, 1883.

I DESIRE, in the first instance, to express my great indebtedness to the members of our Society, and more particularly to our worthy and painstaking Secretary.

It is now some years since I heard indirectly that a few amateur microscopists had originated and organised a Society for the purpose of circulating such objects as can be permanently mounted for examination. This Society became the means of providing pleasant and instructive evenings for many who live in localities where libraries and lectures on scientific subjects are not to be had. We can now, by means of the "Postal Microscopical Society," enjoy, at the hours most convenient to ourselves, the specimens prepared by its members, and study the notes on the

same, accompanied as they so often are by carefully-drawn illustrations. This is one of the advantages of that Society, at whose Annual Meeting we have this evening assembled.

But there are some disadvantages in confining the range of objects exclusively to such things as can be mounted, thus excluding that very great source of interest to the microscopist—the movements of the lower members of the animal and vegetable kingdoms. I should be glad to hear the opinions of some of the members present, as to the desirability and possibility of circulating small bottles or tubes, containing specimens of Stentors, *Hydræ*, *Flosculariæ*, and the like, not omitting the favourite Water-Mites. At the same time, knowing that these things have not an equal charm for all, I would propose that members who are fortunate enough to find colonies of such genera as *Melicerta*, *Stephanoceros*, or *Stentor*, be asked to announce the fact in the Note-Books, and in our "Quarterly Journal." Then, with the understanding that the cost of postage be defrayed by the member desiring the object, a specimen could be obtained with little trouble. I suggest this partly to introduce a new field for study, because there is a tendency to repeat the objects circulated; if the very same thing is not sent round over and over again, at any rate, there are certain kinds of specimens which appear in almost every box.

Many, if not all of us, regret that we so often allow the books and collections of slides to pass through our hands without additions; but so far from this being any indication of slight to the senders of objects, it is often inevitable, and occurs sometimes from want of time, sometimes because the notes already given are so full as to leave no room for additions, and, now and then, because a member's special line of study is not represented.

In thinking about a subject on which to make a few remarks this evening, it occurred to me that our microscopes might be well employed in examining occasionally the food we eat, or the clothes we wear. Take, for example, that most objectionable, but at the same time exceedingly interesting subject, the *Trichina*. This irrepressible and inquisitive little being, who requires his host not only to lodge but to board him, and to board and lodge not

himself alone, but his descendants to an unlimited number of generations, all of whom he expects to be included in the entertainment. The *Trichinæ* were first seen with the naked eye (in 1835) by a surgeon at Bartholomew's Hospital; they were also noticed in dissecting-rooms by other persons, about the same time. Their name was given by Professor Owen. When thoroughly domiciled, the muscle which they have colonised looks as if it had been well peppered, owing to the presence of small, gritty, greyish-white granules, which are the roundish, partly calcified cysts, containing the entozoa.

During an epidemic, which extended over some years, in the duchy of Brunswick, nearly 1,000 persons suffered from the trichinous disease, but its nature was not clearly ascertained until afterwards. Then a gentleman, who had suffered during the epidemic, consented to have some of his own muscle removed for examination, and under the microscope the *Trichinæ* were seen. (This procedure was simplified some few years ago by a physician, who contrived a kind of muscle-tester, viz., a small silver tube 1-10th of an inch or less in diameter, containing a kind of piston with a sharp point, and a hook like a lady's crochet-hook. The sharp point enables the instrument to be inserted into a muscle, and before the whole is withdrawn the hook is first protruded and then drawn into the ensheathing tube, and, passing through a slot in the side of the tube, takes with it a fragment of the muscle in which it was imbedded. Probably the quantity thus removed would be too small for estimating the actual amount of the diseased condition, but is useful to ascertain the fact of the disease.) It is comforting to know that in this country the disease is extremely rare, and that most of the meat brought to English tables has been cooked at a temperature high enough to kill all the *Trichinæ* that may have been present.

One other unpleasant meat colonist is the "pork-measle," which is the tape-worm in its larval state. The pig who houses these larvæ has swallowed the eggs in his food or water, and after being hatched they have migrated from the viscera into the tissues, enlarging and developing into ovoid hydatids. In dimension these larvæ vary from the size of a pea to that of a bean, and they resemble bags of water, having this peculiarity,

that though the containing cavity is oval, the *cysticercus* itself is shaped like a soda-water bottle, with two or three extra lengths of neck; and the manifest moral of this tale is that when meat contains oval cavities about $\frac{1}{4}$—$\frac{1}{2}$ an inch in length, filled with fluid, it should be rejected as unfit for food, but will probably reward careful inspection under a two-inch object-glass. Those persons who swallow "pork-measles" are likely to become the subjects of tape-worm. Happily the eaters of meat, when thoroughly cooked, find that the germs and all lurking traces of animal life are destroyed, while those who venture on meat which has only known a boiling-point heat, may find these germs developing after all.

The starches which form so large a part of our daily food have, as is well known, a characteristic reaction with free iodine, and an equally characteristic behaviour with polarised light; the black cross in each starch grain becomes coloured when a selenite is placed under the object. A slide which has been sent round the Society this year shows the cells in their natural arrangement in the potato; fortunately the tuber can be easily cut into the thin slices required to show them. And still more recently some capital sections of wheat-grains have been circulated. In these the purple stain used by the mounter had attached itself to the living tissues of the seed, while the starch-cells were unaffected.

The largest starch-cells are those of the *Canna edulis*, a relative of the arrowroot plant. Why does the starch grain show the concentric lines with bright light, and a dark cross with the Nicol prism? The fine lines are the marks of the successive layers of growth, and are, in fact, the edges of a series of minute ridges. Cold water has little effect on starch, but hot water causes the cells to swell. Thus the wall is ruptured, and the contents escape; this may be watched under the quarter-inch objective.

Starch is a substance worthy of a little more extended notice, seeing that we swallow it in one form or another to an amount once or twice the weight of our bodies every year. How much starch does an ordinary adult consume annually in the form of potatoes alone? I imagine, from the large and heaped dishes which I see on the tables of artisans and labouring men, that

one-third of a ton (750 pounds) would be a fair estimate of the yearly consumption of this vegetable by a healthy, hard-working adult, and I suppose that such a quantity would yield about 170 pounds of starch. The arrangement of the starch-cells in the potato is, as I have before said, not difficult to find, and in this part of the country thin sections of some of the tubers would reveal the potato fungus—*Peronospora infestans.* Of this we have had two interesting professional mounts this year in the Society's boxes, showing the resting spores, which appear to be the real source of the mischief, and the fungus itself could also be observed projecting from the stigmata of the leaves.

In examining different kinds of meal with the intention of referring to them in this paper, I found that the chief distinction was in the size of the starch-cells; this was marked in some cases by the fact that starches from different sources were contained in the same specimen, mixed in grinding or in conveyance. Identification of the starch-cells in any given sample, is, I believe, generally managed by comparison with standard slides. The same remarks apply to some of the condiments, in which the presence of foreign matters is to be detected by an eye accustomed to see the genuine article over and over again. Mustard, as is well known, is a mixture, and contains the pounded tissues of several plants, which, when so mixed, are by no means easy to distinguish and identify.

Common Salt, when crystallised on a slide, makes a pretty object, but one not easy to keep in its pristine beauty. Sugar, on the other hand, mounts well, and forms a very fine object for the polariscope; one was lately circulated in our boxes. From sugar our thoughts naturally pass to preserves, and here the microscopist will find much that is interesting, and perhaps also instructive, if he *buys* a sample of preserves and examines it carefully; that is, supposing he is well acquainted with the minute anatomy of turnips and other inexpensive roots.

In speaking of textile fabrics, I must again mention the comparative method, and for this purpose reference slides of pure materials should be prepared. For a standard slide of cotton place a few fibres of cotton-wool on a glass slip, and cover with a little fluid balsam. A standard slide of silk may be made of an

untwisted strand of sewing silk, or much better of a few fragments of the raw material, which may be had from a silk-worm fancier, and which can be mounted in the same way. These, with some raw flax fibres from a piece of genuine linen, a little sheep's wool, and some rabbit's and seal's fur, will form a useful set of standard slides.

Cotton comes from the pod of the cotton plant. Each fibre is like a twisted strap, or waved ribbon, which enables it to obtain a hold or grip on its neighbours. A similar hold is obtained in woollen fibres by the projecting scales, which are so familiar to us in the human hair, and the interlocking of these scales produces in cloth the effect known as felting.

The character of a fabric consisting of a mixture of cotton and wool is thus at once revealed, when the texture has been broken up and spread on a slide. (In describing these structures the term "fibre" is applied to the simplest elements to which any tissue can be reduced.) Linen fibres consist of the fibro-vascular bundles of the *Linum* stem, which have been separated by beating, by which operation they are not only divided, but bruised and softened. When examined under the microscope just after removal from the plant, the fibres are smooth cylinders of almost uniform diameter; but after the process of "scutching," as the preparatory beating is called, each fibre shows several transverse fractures. Cotton and linen fabrics are thus distinguishable by the twisted-tape-like appearance of the former, and the resemblance of the latter to bruised straw.

It is a more important matter to be able clearly to determine what is and what is not silk; the chief admixture in fabrics of this kind is with cotton, whose characters have just been noted. The fibre of silk is smooth, apparently double, and of uniform diameter, the two halves of each thread being produced from different spinnerets of the silk-worm. Silk is a viscid secretion, which solidifies as it exudes.

Fur is worthy of examination. Very much of that which is sold for trimming ladies' dress is dyed to resemble the fur of the animal whose name it bears, but has really come from the back of the rabbit. This may be proved by mounting a few of the hairs in glycerine jelly. The hair of the rabbit appears very much like a ladder. Seal fur is not of uniform diameter, and somewhat

resembles the stem of a hazel, or other branch whose buds are regularly alternate.

Ladies and Gentlemen,—I hoped to have read this paper in person, but have been prevented, and consequently must entrust the reading of it to my predecessor in the Presidential Chair. I trust that you will have a good meeting, and express very sincere regret for my unavoidable absence.

Address on Resigning the Chair.

By Arthur Hammond, F.L.S.

Ladies and Gentlemen,—

IN drawing up for your information a short account of the work done by the members of our Society during the past twelve months, I have to acknowledge the great assistance afforded me by the valuable copy of the contents of the Note-Books supplied to me by our Hon. Secretary, Mr. Allen. This appears to be quite an incidental portion of the services rendered to the Society by that gentleman, and I am quite sure that if any of our members have the curiosity to look at the bulky bundle of manuscripts to which I refer, they will agree with me that the duties which devolve upon the Hon. Secretary of the "Postal Microscopical Society" are by no means a light undertaking. It would be impracticable to notice all the communications which appear in the Note-Books; and a selection therefore becoming desirable, I trust if any important omission is made, that I may receive a kindly pardon. Referring to the Rules of our Society, as stated in the part of our Journal published in December of last year, I find that the purpose of the Society "shall be the circulation, study, and discussion of Microscopic objects, and the general advancement of Microscopy and the Natural Sciences among its members," and much of the utility of the work done,

will, I venture to think, be found embodied in the concluding words of this paragraph—"among its members."

Work of an exclusively original nature scarcely comes within our scope, and is perhaps better fitted to find publicity in the records of our learned societies; and from the majority of our members such work is perhaps scarcely to be expected. We find, accordingly, that a considerable proportion of the Notes in our Note-Books are evidently intended by the writers for the information of their fellow workers, who may not, perhaps, have the time or opportunity to look up works of reference for themselves. Far be it from me to deprecate a practice from which I have myself so frequently derived pleasure and instruction, or to do otherwise than recognise, that by this means the objects of the Society are largely fulfilled. Still, I think that where adequate study has been made of the subject, there will always occur, as indeed there frequently do occur, observations of an original nature not necessarily of scientific value, but such as must greatly increase the interest with which the communications are likely to be read, something beyond what we may expect to find even in the best books of reference; such observations, I may add, make the subject in some sense the author's own. While gladly recognising the extent to which these attributes are found in the work of many of our members, and the excellence of the illustrations with which they are frequently adorned, I take this opportunity of indicating one direction in which I venture to think improvement is still possible.

I have drawn up and annexed a classified list of the various subjects treated of in the Note-Books, and shall content myself here with mentioning a few which seem specially worthy of notice.

I think it will scarcely admit of question that the notes and illustrations of Messrs. Elcock and Malcomson on the Foraminifera must claim the first place in any notice of the work of our Society. From the former of these gentlemen we have six communications on this subject, containing full and most interesting details on the species treated of, and forming a valuable introduction to the study of these beautiful forms of lowly organised existence, especially to those of us who were able to give them careful attention in connection with the slides. The

difference between the Arenaceous, Porcellanous, and Hyaline Groups have been well exemplified, and the curious phenomenon of isomorphism adequately pointed out.

Mr. S. M. Malcomson's notes on the same subject have worthily seconded those of Mr. Elcock, special reference being made in the case of *Bigenerina* to the dimorphic growth of the shell, from an early biserial arrangement to a straight axis at a subsequent period. Mr. Malcomson is also the author of some valuable notes on the Ostracoda in reference to a slide of *Cypris virens*.

Occasionally we find that the notes give rise to useful discussions on disputed points, as in the case of Rev. W. Locock's notes on the mode of attachment of flies' feet; and the identity of a supposed Cidaris spine by Miss Henty. We may note how sometimes a slide that has been sent round the Society's boxes *usque ad nauseam* without any information, may suddenly become valuable by a little expenditure of time and patience upon it, as for instance Mr. D. G. Prothero's and Mr. E. Hopes' slides of Spinal Cord.

Among the Notes relating to the Crustacea, we find one written by our late lamented friend, Col. H. Basevi, viz., that on *Palinurus vulgaris*. The tribe of insects as usual attracts a considerable number of writers, many of whom have sent us interesting communications, from which it is difficult to make a selection. Those of Mr. C. F. George and Mr. R. H. Moore on the Water Mites may perhaps be mentioned. The Infusoria do not appear to attract all the attention they deserve, perhaps on account of the difficulty of preparing good slides such as will give any adequate idea of the appearance of the creature during life. A very successful attempt, however, in this direction comes recently from the fertile pen of the Rev. C. H. Waddell, on what appears to be *Epistylis Plicablis*. Mr. A. Milroy's slides and notes on Morbid Anatomy are welcome contributions in a field otherwise almost unknown to our members.

In the department of structural Botany, the signature of the Rev. W. H. Lett meets us with marked frequency, as does that of Mr. C. V. Smith, whose beautiful slides we have so frequently admired. A very interesting note on *Utricularia* and its curious

bladders reaches us from Mr. G. Norman. Amongst the Algæ again Mr. Lett comes to the front with notes on *Cladophora*, *Nostoc*, *Zygnema*, and *Hyalotheca*. The Micro Fungi are taken up by Messrs. Whitefoot, Steward, and Norman; the latter has also a very interesting paper in the Journal on the *Saprolegnieæ*. Mr. J. C. Christie represents Micro-Geology, and Mr. H. M. Klaassen gives us an account of crystals deposited upon rounded grains of sand. I think we have reason to congratulate ourselves upon the frequency with which the names of lady members appear in our notes, those of Mrs. Cowen, and the Misses Glascott, Henty Hippisley, and Jarrett, appearing prominently.

Notes have been written on the following :—

VERTEBRATE ANIMALS.

Mundy, G. B., on Upper Jaw of Cat.
Tutte, E., on Skin of Chameleon, followed by Mrs. A. Pennington.
Prothero, D. G., On Small Intestine of Cat.
Waddell, C. H., on the Pollan, or Fresh-Water Herring.
Hall, R., on Tongue of Cat.
Prothero, D. G., on Spinal Cord, followed by A. Hammond and H. F. Parsons.
Hope, E., Spinal Cord.
Narramore, W., on the Supra Renal Capsule.
" Skin of Hand.

CRUSTACEA.

Epps, H., on Barnacles.
Mc Kee, W. S., Glass Hand of Balanus.
Hammond, A., on the Structure and Economy of the Daphnia, (Presidential Address, Journal).
Malcomson, S. M., on the Ostracoda (Cypris virens).
Basevi, H., Palinurus vulgaris
Lovett, E., Squilla Demarestii.

INSECT STRUCTURE AND HISTORY.

Bostock, E., Corethra plumicornis.
Moore, R. H., Dolichopus nobilitatis (gen. organs of).
" Stenopterix hirundinis.

Wright, John, Diamond Beetle.
Fitch, F., The Fly (Journal).
Hammond, A., Drone Fly, Abdomen of.
„ Notonecta striata
„ Stratiomys Chameleon (skin of larva).
„ Maggot of Blow Fly (Journal).
Appleton, W. M., Eggs of Gad Fly, followed by C. F. Coombs.
Cox, C. F., Antennæ of Gnats.
Tait, W. C., Nycteribia and Hippobosca.
Bygott, R., Sting of Wasp, followed by C. F. George.
Smith, J., Parasites on Wing of Moth.
Hope, B., Hairs of Larva of Vapour Moth.
Turtle, F. L., Psychoda phalsenoides.
Fenton, M., Antennæ of Vapour Moth.
Horsley, W. H., Aphrophora spumaria.
Wilson, H. J., Amopheles bifurcatus.
„ Scales of Lepisma.
„ Ornithomya avicularia.
Locock, Rev. W., Foot of Breeze-Fly, followed by R. S. Hudson, S. R. Barrett, A. Pennington, and R. Smith.
Bailey, Rev. G., Forficula auricularia.
Green, Rev. J. H., Velum and Strigilis of Bee.
Epps, H., Leg of Curculio.
„ Elytron of Cricket.
Crewdson, Rev. G., Head of Cockroach, followed by Rev. E. T. Stubbs.
Jarrett, E. E., Chrysis ignita.
„ Forest Fly, Hippobosca equina.

ARACHNIDA.

George, C. F., Arrenurus viridis, followed by R. H. Moore.
„ Eylais extendens.
„ Rhyncolophidæ.
„ On the Palpi of Fresh-Water Mites, as Aids to distinguishing Sub-Families (Journal).
Bostock, E., Tegeocranus latus.
„ „ elongatus.
Hunter, E., Desmodex folliculorum.

Barrett, S. R., Gamasus from Fly.
Stokes, A. W., Gamasus coleoptratorum.
Hammond, A., Phalangium.
Halsey, J., Sea-Spiders.
Baddeley, W. H., Sting of Scorpion.
Wilson, J. H., Spinnerets of Garden-Spider.

ECHINODERMATA.

Henty, M. A., on Cidaris Spine, followed by R. H. Moore, C. N. Peel, and E. E. Jarrett.
Green, Rev. J. H., Tube Feet of Echinus sphæra.
Glascott, L. S., Spines of Echinus, followed by B. Bryant.
Green, Rev. J. H., Skin of Pentacta.

MOLLUSCA.

Henty, M. A., Palate of Haliotis.
Ridpath, D., Palate of Limpet.
Cooke, J. H., Palate of Whelk.
Tutte, E., on Oyster-Shell, followed by Hon. J. G. P. Vereker.
Parsons, H. F., Ammonites plavicostatus.

POLYZOA.

Hippisley, M. S., Amathia lendigera.
Brown, G. D., ditto.
„ Fossil Polyzoa from Suffolk Crag.
„ Eschara foliacea.
Pennington, Annie, Bicellaria tuba.
Green, Rev. J. H., Menipea cirrhata.
„ Scrupocellaria reptans, followed by G. D. Brown.
Barrett, S. R., Polyzoary from Agullhas Bank.
Burbidge, W. H., Bowerbankia imbricata.

ZOOPHYTES.

Pennington, A., Aglaophenia pluma.
Hippisley, M. S., „ carnata.
Brown, G. D., Gorgonia
Partridge, T., Hydra fusca swallowing a Naid.
Fenton, M., Plumularia cristata.

Lyall, T., Salicornaria.
Searle, A. H., Sertularia pumila.

INFUSORIA.

Grenfell, J. G., Ceratium tripos, a Cilio-flagellate Infusorian.
Waddell, Rev. C. H., Infusorian on Potamogeton Leaf, followed by S. Mills and J. G. Grenfell.

FORAMINIFERA.

Elcock, C., On the Genus Nonionina.
,, Foraminifera from Atlantic Dredgings.
,, Truncatulina lobata.
,, On the Phenomenon of Isomorphism in different groups of Foraminifera.
,, Haplophragmium pseudospiralis.
,, Pulvinulina Menardii.
Malcomson, S. M., Bolivina dilatata.
,, ,, Bigenerina nodosaria as illustrative of Dimorphic Growth.
,, ,, On the Genus Miliolina.
,, ,, Textularia sagittula.
Bailey, Rev. G., Foraminifera in Red Chalk.
Pennington, A., Nummulites.

MORBID ANATOMY.

Milroy, A., Amyloid Disease of Liver.
,, False Pigmentation of Lung.
,, Acute Cirrhosis of Liver.
Crowther, G. H., Morbid appearance resembling Caries produced in Human Tooth by prolonged Maceration in a solution of Sugar.
Cooper, F. W., Bacillus anthracis.

STRUCTURAL BOTANY.

Lett, Rev. W. H., Arctium lappa, Burdock, Section.
,, Acrostichum alcicorne.
,, Fraxinus excelsior, Section.
,, Fern Spores, Todea superba.
,, ,, Dicksonia antarctica.

Lett, Rev. W. H., Hippuris vulgaris.
„ Pæony Petiole.
„ Utricularia Bladders.
Smith, R , Sections of Wheat through the Germ.
Jarrett, E. E., Yucca, Cuticle of.
Smith, C. V., Fall of Leaf: How accomplished.
„ Maize Root, Section through growing point.
„ Sieve Tubes of Cucumber.
„ Sori of Male Fern.
Henty, M. A., Pollen, Difference between Wind and Insect fertilised.
Waddell, Rev. C. H., Fern Spores, Todea superba.
„ „ Neprolepsis Davallioides.
Fisher, J. W., on Withered Leaves (Journal).
Cowen, A., Raphides in Lesser Duckweed.
Hippisley, M. S., Fern Spores, Dicksonia Antarctica.
„ Utricularia Bladders.
Klaassen, H. M., Milkwort, Polygala vulgaris
Grenfell, J. G., Ramenta of Fern.
Halsey, Rev. J., Seeds of Spergularia marginata.
„ Seeds of Sea Campion, Silene maritima.
Holmes, C. D., St. John's Wort-Leaf, Perforations in.
Hunter, E., Sphæraphides in Echino-cactus.
Barrett, S. R., Stamens of Sore Eye Plant, followed by W. C. Tait.
Vereker, J. G. P., Thistle Seed.
„ Epidermis of Maize.
Norman, George, Utricularia Bladders.
Kempson, A., Alpine Rose, Leaf of.
Rookledge, J., Alsia, Stamens of.
Cheesman, W. N., Butcher's Broom.
„ Duckweed, Reproductive Organ of.
„ Utricularia Bladders.
Epps, H., Section of Cocoa-Bean.
„ Anthers of London Pride.
Appleton, W. M., Section of Cherry Stone.
Moore. R. H., Durio zibethinus.
„ Section of Mistletoe.
Fisher, W. J., Eupactis latifolia.

MOSSES.

Cheesman, W. N., Aulacomnium androgynum.
„ Pottia minutula, followed by C. H. Waddell.
Waddell, Rev. C. H., Bryum Wahlenbergii.
„ Hedwigia ciliata.
Fisher, J. W., Lycopodium clavatum, followed by H. F. Parsons and H. Epps.
Gough, T., Sphagnum.
Cowen, A., Schistostega pinnata, followed by H. F. Parsons.

ALGÆ.

Hudson, R. S., Bacillus tuberculosis.
Parsons, H. F., Batrachospermum, to mount.
Cheesman, W. N., Chara, Reproductive Organs of, followed by H. Pocklington.
Lett, W. H., Gloiotricha gigantea, followed by L. S. Glascott.
„ Cladophora glomerata.
„ Nostoc commune.
„ Zygnema cruciatum.
Jarrett, E. E., Draparnaldia plumosa.
Lett, H. W., Hyalotheca dissiliens. Desmidiaceæ.
Dunlop, M. F., Cosmarium. „

FUNGI.

Whitefoot, Thos., Strawberry Brand, Aregma obtusatum.
„ Bramble Brand, Phragmidium bulbosum.
„ Triphragmium ulmariæ, Meadow-Sweet Brand, followed by J. W. Steward.
Steward, J. W., Aregma obtusatum.
„ Puccinia glechomatis.
„ Violet Smut, Urocystis violæ.
Epps, H., Coffee Fungus.
Maynard, H. L., Geoglossum.
Norman, Geo., Nectria Cinnabarina.
„ Peziza polytriche.
„ Spumaria alba.
Waddell, Rev. C. H., Peronospora infestans, followed by C. P. Coombs.

Lett, Rev. H. W., Stemonitis fusca.
Norman, Geo., on the Saprolegnieæ (Journal).

DIATOMS.

Peal, C. N., Diatoms to mount dry.
Brown, G. D., Diatoms from Hong Kong.
„ „ from Moron.
Moore, R. H., „ from Ancient Roman Baths.
Baddeley, W. H., Rhizosolenia styliformis.
„ Triceratium undulatum.
Tutte, E., Santa Monica Earth, a Communication from the San Francisco Microscopical Society, through the late Mr. Nicholson.

MICRO. GEOLOGY.

Parsons, H. F., Section of Belemnite.
„ Silt from Sutton Bridge.
Jarrett, E. E., Bryozoic Rock from Clifton.
Cowen, A., Sunstone.
„ Zeolite.
Klaassen, H. M., Crystals deposited on rounded grains of sand.
Crewdson, Rev. G., Carboniferous Limestone.
Ford, J., Sections of Sigillaria.
Moore, R. H., Cup Coral, Cyathophyllum, followed by H. F. Parsons.
Christie, J. C., Dolerite.
„ „ Porphyritic.
„ Horneblend Schist.
„ Norite.
„ Graphic Granite, followed by J. Smith.
Smith, J., Eozoon Canadense, followed by S. M. Malcomson.
„ Endothyra ammonoides.
Gough, T., Gneiss.
„ Syenite from Cleopatra's Needle.
Dannatt, Geo., Serpentine.
Goodwin, W., Scotch Kieselguhr.

VARIOUS.

Hammond, A., Tubifex rivulorum, Reproductive Organs of (Journal).
Henty, M. A., Boring Sponge, followed by E. E. Jarrett, Rev. J. H. Green, and G. D. Brown.
Basevi, H., Gemmules of Sponge.
Hunter, E., Bichromate of Potash for Cleaning Diatoms.
Cowen, A., On the Application of the Microscope to Geological Research (Journal).
Pocklington, H., Cyanotype Printing.
" To Prepare Cuticles of Plants.
Smith, J., Calcareous Substance from Boiler.
Epps, H., on the Size of Dust Particles of Wheat and Coal (Journal).
Mackenzie, J., To Cut Cells in Glass Slips.
Dibden, W. J., On the Bursting Point of Starch Cells (Journal).
Brown, G. D., Dry Mounting with Gutta Percha Tissue.
Elcock, C., On Gum for Mounting Foraminifera.
Coombs, C. P., On the Exhibition of Magnified Objects (Journal).
Teasdale, W., Glass-Ruling.
Smith, J., On Making and Mounting Rock Sections (Journal).
Hunter, E., A Medium for Mounting Animal-Tissues.
Horsley, W. H., On Mermis.
Lovett, E., A Day's Shore Hunting among the Low-Tide Pools of Jersey (Journal).

Living Bacilli in the Cells of Vallisneria.

By Dr. T. S. Ralph, Victoria.

I HAVE demonstrated the presence of these organisms at the Royal Society of Victoria, at the Microscopical Society, and also at the Microscopical Section of the Linnæan Society, Syd-

ney. There is a little difficulty attending the demonstration, but if the following directions are followed and carried out with other water-plants, I believe these objects will be seen:—A thin section of the cuticle of the leaf of *Vallisneria* should be sliced off, so as to increase the light passing through the cells. The specimen must be placed on a slide, with the cuticular surface next the cover, and then the slide should be placed on a rest, with the cover downwards or towards the table, and remain there for five minutes at least, in order to allow these organisms to fall on to the cuticular walls of the cells, and then examined under a quarter-inch object-glass = 250 diameters. These bodies must be looked for in the quadrate cells, and will be seen moving about the chlorophyll grains, even when cyclosis may be going on; and after the lapse of some minutes they will gravitate out of sight, or be found heaped together at the lower end of the cell (or apparent upper end).

It is this circumstance which has prevented any recognition of their presence in this plant. These organisms measure 1—5,000th of an inch in length, possess a distinct motion of their own, and increase in size as the cells lose their vitality. I have obtained these results from specimens of *Vallisneria* grown under any or all conditions, with the leaves perfectly healthy and green; from the narrow variety, resembling the European form; and from our large Australian one, with leaves from five to six feet in length and one inch in breadth and a considerable thickness of lamina, so that sections can be cut "edge on" to the leaf. These objects are rarely, if ever, seen in the long, deep-seated cells, which exhibit cyclosis so beautifully in this variety. After the application of carbolic acid with heat to decolourise the specimen, I have witnessed the movement of these Bacilli, although the acid had disintegrated and disorganised the other cell-contents. So much for vitality! How much for carbolic acid in directly killing these vermin? I wish the stipules of *Hydrocharis* could be examined with a view to determine their presence. *Anacharis* has yielded some.

The Foraminifera of Galway.

By F. P. Balkwill and F. W. Millett, F.R.M.S.

Plates 1, 2, 3, 4.

IN the summer of 1879, the 25th of the seventh month, business engagements took F. P. Balkwill to Galway, and having an hour or two to spare, he went to the shore and scraped up about 14 lbs. of fine sand from as many different places as possible: around the base of rocks and large stones which there abound near low water; from the sides and bottoms of a few small half-tide pools; and from the flats of white sand which stretch up to high-water mark, and are so hard as scarcely to record a footprint or show a ripple-mark on their fine surface. He used an iron spoon, which was procured for the purpose, and in scraping carefully took the surface-sand, especially following the wave-lines near high-water mark to secure the Foraminifera which had been floated and left there by the receding tide, and those lines of drainage, where the Foraminifera are similarly deposited by water flowing down the shore in small streamlets.

On examining this sand after his return to Dublin, he found that it was rich in the smaller forms of Foraminifera, and that in some respects it corresponded more with that he had previously examined from Lough Foyle, and also the adjacent boulder-clay of Limavady junction, than that with which he was more familiar from the Dublin shores.

He therefore resolved to obtain a larger supply, and from a more extensive shore-surface when next an opportunity might occur. Within a day or two of the same time next year, business again called him to Galway, and after collecting as before, the next day he took a tram-car to Salthill, a suburb on the Bay, about two miles west of "the city of the Tribes."

Skirting the coast by the road, which is elevated above the beach, he proceeded westward until it diverged to the right, and by a pathway round a wall emerged on to long flats of green sward,

characterised by the dwarfed growths of *erodiums* and other sea-loving plants in exposed places; beyond these flats was a peninsula or miniature promontory, surrounded by a far-spreading *débris* of disintegrated rock which the sea, washing it on both sides, had detached from its low cliffs, and at a radius of a quarter of a mile had deposited in a circle from its point. Descending to a stream on the right or north side of the isthmus, he collected a little from the bay on that side, and following the peninsula, where the aforesaid stream, becoming shallow, poured over the sand, he got Sertularias and seaweeds, and added these to his store, thinking some Foraminifera might be parasitic or adhering to them.

He examined the boulders and rocks around the peninsula, but the stones were too coarse, or the exposure to the breakers too great, for much fine sand to lodge among them, so that but little was added to the canvas-bag in a mile or more of very uneven walking.

Scrapings, however, were taken from every promising spot, of which there were several nearer Salthill. The shore is here indented by numerous little coves, separated by rocky or stony spurs, which cut up the margin of the shore from the peninsula to Salthill.

These inlets afford shelter for the accumulation of fine sand. On one of them was a mass of growing vegetation, from the tangled roots of which also sand was taken. He could not determine the name of the plant: it was growing in the sand, where it is covered by every tide. On approaching Salthill, the inlets were rich in floated Foraminifera about high-water mark, so that when he arrived there his bags were heavy with wet sand.

What was in that load, it is the purpose of this paper to unfold so far as Foraminifera are concerned. And now arises the question, "What are Foraminifera?" Foraminifera are "Reticularian Rhizopoda," having shells or tests. They are, in fact, minute masses of protoplasm, which secrete or excrete a stony cell-wall, which is usually either perforated with minute holes—foramina, or having one or more larger apertures—through which the protoplasm, in long, filamentous threads, called pseudopodia, often many times the length of the shell, protrudes itself. These pseudopodia inosculate by uniting whenever they meet or cross

each other, and thus form a living network, along the various lines of which the granular matter of the protoplasm flows freely. This circulation differs from that in the hair of a sting-nettle, where it is confined by the lining membrane of the cell-wall, or the fovilla in the pollen tube, inasmuch as it is not confined by a membrane, but circulates on the outside of a viscous network in the medium of salt or brackish water.

When any prey, such as a minute diatom, touches this net, it adheres, more protoplasm flows over and embeds it; the nutriment is absorbed and the refuse rejected. Thus nourishment goes on outside the shell.

Except in the one-celled Foraminifera, as the animal grows it adds fresh chambers, each being generally larger than the last, the aperture of which forms its centre of origination as its own aperture forms its completion. Thus, from the earliest to the last segment, one opens into the next, whilst the creature inhabits them all simultaneously.* These organisms are found all over the ocean bottom. They are to be met with on every seashore, whilst some forms are more peculiarly plentiful in brackish water.

The shells are of three principal structures:—The Porcellanous, or opalescent, are white by reflected, amber-coloured by transmitted light. These emit their pseudopodia in a branching trunk from one aperture, but have no foramina.

The Hyaline, when young, are like glass becoming white or semi-opaque with age. These are foraminated, emitting pseudopodia from these pores, as well as by their aperture, and sometimes investing their shell in sarcode, which emits the pseudopodia. These two groups are calcareous.

The third kind are Arenaceous, or made up of grains of sand cemented together. These are frequently silicious—boiling *liquor potassæ*, in most cases, does not dissolve the cement by which they are formed. These are often tinged, more or less, brown or orange by the oxide of iron probably, as intimately associated with the protoplasm of these minute organisms as with that of the higher developments of the entire vegetable and animal kingdoms.

Of these microscopic shells in the deep oceans and shallower

* See Williamson's Foraminifera, Ray Society, 1858, for further details, and Carpenter's Introduction to Foraminifera.

seas have rocks been formed, from arctic to tropical climes, even from the Palœozoic age. To study these is the work of the geologist; but he will tell us that many species which we are familiar with in the British waters of to-day have remained unchanged since the era of the formation of chalk.

The question of species is one of great uncertainty. Some forms, such as those alluded to, we recognise from Mesozoic times, in which, though now we may find occasional varieties, the type seems constant and all but uniform—as *Lagena Williamsoni*. Others are so protean that we recognise their very want of stability, in form. Yet something about the structure makes us unhesitatingly pronounce the aberrant group but one species—as *Truncatulina lobatula*. Again, we have a genus, whose allied species it is almost hopeless to attempt to dogmatise about, so endlessly do they change and run into each other, where some of the so-called species are definite and clear enough—as the *Polymorphinæ*. Whilst our knowledge of the life and development of the living animal is so small, we have to put up with a more or less artificial arrangement.

Patient observation of the living organisms themselves is required to throw a fuller light on the subject, and clear up some points which the systematist requires as data to enable him correctly to interpret some problems connected with the genealogy of these heirlooms of time.

In taking a general review of the Foraminifera of the gatherings on this part of the coast, one is struck by a few leading differences as compared with that from many localities in Great Britain. Amongst these may be noticed the absence of *Biloculina ringens*, the moderate frequency of *Miliolina fusca* and *Ammodiscus gordialis*, and the occurrence of a few fine specimens of *Ammodiscus Shoneana*.

The flattened forms of *Lagenæ* are remarkably abundant, giving rise, as might be expected, to varieties, and including some of the rarer forms, among which may be mentioned *Lagena pulchella*, *L. faba*, *L. bicarinata*, *L. fimbriata*, and *L. clathrata*, the last two not having been before recorded as British species, and a variety between *L. clathrata* and *L. castrensis*.

Lingulina carinata is also remarkable. The *Nodosarinæ*,

Dentalinæ, and *Cristellariæ* are but poorly represented. Among the *Polymorphinæ* we have the rare *Polymorphina myristiformis*, *P. complanata*, a species new to Great Britain, and an example of *P. compressa*, with a short Entosolenian tube. *Globigerina bulloides* occurs plentifully, and is accompanied by the rarer *G. inflata*.

Among the *Textulariæ* and *Bolivinæ*, *Textularia difformis* is remarkably frequent, *Bolivina lævigata* and *B. dilatata* being also more common than usual on the east coast of Ireland; on the other hand, the rarity of *Verneuilina polystropha* is equally striking.

The Buliminas, including *Virgulina Schreibersii*, are well represented, and the material is especially rich in its *Cassidulinæ* and *Discorbinæ*, of the latter, the frequency of the beautiful *Discorbina Parisiensis* and of *D. Wrightii* is remarkable. The latter often occurs double and sometimes treble, the faces of two or more specimens being applied together, suggesting a process of gemmation or embryonic adhesion (as also the double and probably trigonal Lagenas). *D. orbicularis*—first noticed as British by Balkwill and Wright, in their Dublin shore-gatherings—occurs seldom in the typical form, but its wild-growing variety is extremely common.

Operculina ammonoides, of which we have a few specimens, is not often met with.

These general remarks must close by the notice of a *Ramulina*, new to Britain, of which the species is as yet undecided.

PORCELLANOUS GROUP.

Cornuspira involvens.—This consists of a fine tube, springing from a central chamber or umbo, and after two or three turns in the same plane, the diameter of the tube, which is nearly circular, increases considerably. This species is often found in half-tide pools.

Biloculina depressa.—A broadly oval, flat Biloculina, with a linear aperture extending the whole breadth of the somewhat truncated anterior end; this and a broad, flat margin are formed by the junction of the two surfaces. As in the *Miliolinæ*, the chambers open at alternate ends of the shell. Extremely plentiful in the deeper parts of the Irish Sea; it is rare here.

MILIOLINA TRICARINATA.—This shell, triangular in section, has plane sides somewhat resembling a plump beech-nut kernel. It occurs but sparingly.

MILIOLINA AUBERIANA is triangular, somewhat like the last species, but one of the sides is shorter than the others, of which one is pierced by the acute edge of an earlier segment.

MILIOLINA OBLONGA.—This is an elongated form, closely allied to *M. seminulum*, and is frequent.

MILIOLINA SEMINULUM.—One of our commonest species, a highly-polished, broadly oval form, with rounded edges; frequent.

MILIOLINA SECANS.—Our largest British Miliolina is very flat and thin, with sharp edges, broadly oval to round. It is frequently marked by transverse, curved wave-lines of growth; common.

MILIOLINA SUBROTUNDA.—In some gatherings, the predominant form, with roundish segment, often broader than long, the inner margin of every segment forms an adhering rim to the segment it clasps; the surface often flattened, wavy, and irregular; common. A few specimens have rib-like markings on the peripheral margin.

MILIOLINA BICORNIS has longitudinal striæ, and a more or less flattened mouth. There is a tendency for the inner segments to be heaped up in the middle of one surface, while they are scarcely seen on the other and flatter side; rare.

MILIOLINA BRONGNIARTII, a variety of *M. bicornis*, with a rounder and protruded aperture; very rare.

MILIOLINA FUSCA, a small, oblong, brown, arenaceous Miliolina; though "rare," yet, by comparison with its rarity elsewhere, it is frequent.

MILIOLINA SCLEROTICA.—This rough, angular Miliolina has an appearance approaching to arenaceous; there is a similar shell, with round, inflated chambers; may be but a variety of *M. seminulum;* frequent. We should say neither was truly arenaceous. Many of the specimens closely resemble the *Quinqueloculina contorta* of D'Orbigny in form, but his species, as described by him, is smooth.

SPIROLOCULINA PLANULATA—a few small specimens. Here we have long, narrow chambers, arranged biserially, in one plane, forming a broad ellipse, chambers opening alternately at each end. The specimens are hardly developed enough to decide whether they belong to the group, "*Planulata*" or "*Limbata*," but the limbate sutures not being apparent, it seems safe to class them with the former.

ARENACEOUS FORMS.

This class is obsolete, being artificial; the term is only used for convenience. We have already noticed *Miliolina fusca*, and shall speak of *Textularia gramen* among the TEXTULARINÆ.

GAUDRYINA FILIFORMIS commences with a triserial, but continues very soon with a biserial arrangement of chambers. This distinguishes it from *Textularia biformis*, which commences with a spiral turn, otherwise they are alike; rare.

VERNEUILINA POLYSTROPHA—the arenaceous form of *Bulimina*—a triserial arrangement of sub-globose orange or yellowish-brown chambers. Very common in many places; rare.

HAPLOPHRAGMIUM CANARIENSE.—A lemon or orange-coloured delicate, lustrous, nonionine shell, bilaterally symmetrical, or nearly so; the last chamber overhanging and the mouth an oval aperture transversely set; common.

HAPLOPHRAGMIUM GLOBIGERINIFORME.—Similar in colour and texture to the last species, but smaller, its more globose segments built up somewhat like *Globigerina bulloides*; very rare.

HAPLOPHRAGMIUM GLOMERATUM (Brady).—Similar to the last in colour and texture, but somewhat fusiform, with long and narrow chambers; very rare.

AMMODISCUS GORDIALIS.—An arenaceous tube of fine texture, and rich orange or yellow colour, twisted more or less into a knot. It is comparatively frequent, being a rare form.

AMMODISCUS SHONEANA, similar to the last in colour and texture. The tube is curled upon an axis into a lengthened sugar-loaf, spiral. It is a minute form. Two or three specimens were bent near the middle; rare.

TROCHAMMINA SQUAMATA.—This brown, flat form is more or less acute at the inferior margin, and consists of two or three turns of a depressed spiral of chambers, something like a bun with thin edges; rare.

TROCHAMMINA OCHRACEA.—A variety, with chambers flush above and radiating irregularly, curved, limbate sutures below; rare. We have found several specimens of the species described by Williamson under the name of *Rotalina ochracea* ("British Foraminifera," p. 55, Figs. 112 and 113). Parker and Jones, in their revision of Williamson's nomenclature in "Carpenter's Introduction," ascribed the species to the genus *Discorbina*, but it is minutely

arenaceous, and clearly a *Trochammina*, closely allied to *T. squamata*. Parker and Jones figure a thick specimen in their "Foraminifera of the North Atlantic and Arctic Oceans," page 407, Pl. XV., Figs. 30, 31. They note its resemblance to some of the *Discorbinæ*, but do not appear to have identified it with Williamson's species.

TROCHAMMINA INFLATA is a brown, polished shell, with subglobose, inflated chambers, reminding one of *Rotalia Beccarii.* It has a few deep-coloured, small initial chambers, visible on the upper surface; frequent.

TROCHAMMINA MACRESCENS, also brown, with a sunken, shrivelled appearance of chambers; very rare.

TROCHAMMINA PLICATA.—Terquem, in his essay on the "Recent Foraminifera of Dunkerque," second fascicule, page 72, Pl. 8, Fig. 9, describes a form to which he gives the name of *Patellina plicata.* We have found a few specimens which are apparently identical with his species, but they are finely arenaceous, and must be assigned to the genus *Trochammina.* Terquem does not mention that his examples are arenaceous, but it must be understood that he attaches little importance to the material of which the shells are composed. This variety of *T. squamata* differs from *T. ochracea* in having fewer chambers in each whorl (six being the number in each of the specimens discovered; whilst *T. ochracea* has nine or ten), and from the typical *T. squamata* is the tortuous septal wall, and the subdivision of the chambers.

HYALINE FORMS.

LAGENÆ are the simplest hyaline, unilocular shells, having an external or internal tube. When the neck is produced into an external tube, it is said to be "ectosolenian"; when, by invagination, the tube is internal, it is called "entosolenian." The young shell is transparent, like glass, becoming frosted by age from the accumulation of shell-matter, traversed by minute tubes, which give an opacity to certain parts, or to the whole of the surface. The shell does not increase in size, from which it may be inferred that the animal is full grown before it begins to secrete the shelly matter.

Some authors are inclined to include the whole group as one species, so many inosculating forms connect all the so-called species.

On the other hand, the number of these is very small, compared to the vast numbers that are fairly true and persistent in most of the well-recognised types, so that, considering that the term species itself is arbitrary, it is open to question, whether forms which have kept true to their distinctive features through geological epochs are not as well entitled to the designation of "species" as any apparently better-marked and differentiated groups of animals. In this case, *Lagena* would rank as a genus, and well-established forms as species.

ECTOSOLENIAN LAGENÆ.

LAGENA SULCATA.—Flask-shaped, meridional ribs, some of which are continued down the neck, straight or twisted spirally around it. Unconnected ribs are often interposed to prevent crowding at the poles; the sulci between the ribs are deep and broad. We figure a curvilinear variety, as *Lagena curvilineata*, of which the typical form is derived from *Lagena striata*. In *sulcata* and some others the curve of the body sweeps into the neck.

LAGENA SEMISTRIATA.—This is like a decanter of moulded glass, with a few short moulded ribs protecting the broadest part near its base. This gives an obcuneate contour to the shell, which is sometimes sub-globose, with the short ribs occurring alternately nearer or further from the base. The tube and lower half of the shell is usually smooth.

LAGENA STRIATA.—Shape oval or oblong; the ribs are much finer and more closely set than in *sulcata*, and the shell is more delicate in outline and structure. The shore-form is usually long and narrow; the length about four times its breadth. In this variety the striæ are continued from the posterior end, and are either straight or twisted on the short tube. In from 40 to 70 fathoms of water, the form is broadly oval; length about twice the breadth or less, with a crown of a double circle of tubercles at the posterior end, the striæ terminating in this crown, and the tube being reticulated by the crossing of longitudinal by transverse spiral striæ. The slightly tapering tube is nearly the length of the oval of the shell. In both varieties the tube is inserted rather abruptly, the oval of the body, not as in *sulcata*, becoming pyriform by sloping to the tube.

LAGENA LYELLII is equally delicately formed. The shell is broadly ovate, with a broad, short, tapering neck, having a castel-

lated broad rim. This neck has a screw spiral, as well as longitudinal striæ. The posterior end has a very short, abrupt, cylindrical tube, and the beautiful striæ which connect this with the neck are closely set, and each usually continues from one pole to the other. We cannot concur in the view that this is a variety of *Lagena sulcata*, but append the remarks of H. B. Brady, F.R.S., hereon at foot.*

LAGENA CLAVATA is smooth, fusiform, or soda-water-bottle shaped, with a long neck and milled rim† at aperture, either obtuse or acute at posterior extremity; frequent. One specimen was found finely striated from end to end (distinct from *L. gracilis*).

LAGENA GRACILLIMA, a fine, tapering, distomous variety of last, lanceolate; both ends accuminate.

Solorina Saccata.

BY ARTHUR J. DOHERTY.

PLATE 5.

THE name Solorina represents a genus of Lichens belonging to the IVth. Natural Order—PELTIDEACEÆ—of Schœrer, and to Leighton's IIIrd. Family, LICHENACEI. The genera *Solorina* and *Peltigera* closely resemble each other in the method of evolving the apothecium, which is at first covered by several layers of cells similar to those constituting the thallus; this "thalline veil" gradually dehisces, and ultimately disappears.

Solorina saccata is found growing upon the earth in moist, shady spots, in sub-Alpine or elevated regions especially on limestone rocks. We found it in a most flourishing condition last May at Miller's Dale, Derbyshire, at which place we are unable to ascertain that there is any record of its having been previously discovered. The thallus is of a leathery or paper-like consistence,

* "I have given up *L. Lyellii* as a quite useless name. When the specimens really differ from *L. sulcata*, they are the first joints of *Nodosaria scalaris*, var. *separans*. Norman suggested this to me years ago, but I was long in arriving at any conviction about it."

† Pointed out by J. S. Wright, F.G.S., Belfast.

and in fresh and moist specimens is of a green colour, which, in the herbarium, changes to grey or greyish-white. The margin is divided by crenatures into lobes; and the upper surface is thinly covered with a white, granular dust, "albo-granulato-pruinose," Leighton. The under-surface is creamy white, and is furnished with numerous prehensile, root-like fibres, termed rhizinæ (ῥίζα, a root), which serve *simply* to attach the thallus to its support. The apothecia vary in colour, from light to dark brown; when immature, they are small, and pressed closely to the upper surface of the thallus, over which they are irregularly scattered. They increase in dimensions as maturity approaches, at the same time becoming urceolate, or concave and sunken; hence the term *saccata*, from Latin *saccus*, a bag or sack.

If a thin, vertical section be taken through the apothecium and thallus, and examined with a magnifying power of three hundred diameters, it will be found

(1) That the thallus consists of three distinct layers, (Plate 5): (*a*) the cortical layer, formed of closely aggregated cellules, the walls of which are more or less distorted, by mutual pressure, from their original spherical shape; (*b*) the stratum-gonidiale, consisting of groups of orbicular granules, filled with a green-coloured matter; (*c*) the medullary layer, formed of numerous intertwining filaments, which branch dichotomously, and in appearance closely resemble the mycelium of Fungi. [Two kinds of thallus structure occur, termed respectively *Heteromerous* (ἕτερος, different; μέρος, a part) and *Homoiomerous* (ὅμοιος, similar; μέρος, a part, the characteristic differences of which are generally well marked.) In the former class, of which *Solorina saccata* is a type, the gonidia and the hyphæ occupy definite and distinct areas; in the latter, these two kinds of tissue are equally blended together in the formation of the thallus.]

(2) The spores, which are contained in asci (ἀσκός, a wine-skin) or hyaline envelopes, are reddish-brown, ellipsoid, thick-walled, and divided across their centre by a septum; and their epispore, or outer wall, is marked by many granular dots or points. They vary greatly in dimensions, in different specimens; but in all they appear to diminish in size towards the circumference of the apothecium. According to Mudd, they measure ·008 inch in length,

and ·0035 inch in breadth. Our own measurements, taken with great care from a large number of specimens, are much smaller, viz.—·002 inch in the major axis, and ·0006th inch across the septum. The asci are placed in the midst of, and are protected by, the paraphyses (literally, that which is produced beside, from παρὰ, beside; φύσις, a production), the coloured clavate apices of which constitute the epithecium. As maturity approaches, the asci ascend towards the epithecium, and there, bursting at their apices, liberate the spores. All lichens which behave in this manner are termed *Gymnocarpous* (γυμνὸς, naked, and κάρπος, fruit); when the spores reach the surface through an opening or chamber formed by a rupture of the extremities of the asci, the lichen is denominated *Angiocarpous* (a term derived probably from ἀγγεῖον, a vessel, and κάρπος, fruit). After liberation, the spore sends out numerous filaments or tubes, which, branching and intertwining, form the hypothallus. Upon this body the medullary layer and stratum-gonidiale are successively deposited, after serving as the basis of which, it ultimately disappears.

The apothecium is the latest development, and when this is perfectly formed, the lichen has attained the highest state of its organisation. In some species (*e.g.*, *Pertusaria communis*), this stage may be never reached, and the thallus only obtains as a mere powdery coating, the thickness of which varies according to the circumstances under which it is produced. The lichen is then termed *pulverulent*, in which abnormal or abortive condition it may continue for centuries, increasing by bisection, and completely veiling its base of support. In other species, the gonidia penetrate the disc of the apothecium, which, in the genus *Pertusaria*, is thus rendered abortive by being converted into little heaps or clusters of powdery bodies, called *soredia*.

The apothecia of *Solorina* are never found growing parasitically upon the thalli of other lichens; though parasitism sometimes occurs between other species. As an illustration, we might name the genus *Sphinctrina*, the stalked or sessile apothecia of which are parasitic upon *Pertusaria*. This class of lichens should, however, be carefully distinguished from entirely different species, whose thalli grow beneath the epidermal layer of bark, or are fleeting or evanescent; such as some *Cladoniæ*, *Caliciæ*, and *Verrucariæ*.

In addition to the three kinds of tissue already referred to as constituting the thallus, an infra-cortical layer of exactly the same structure as the supra-cortical layer, may be distinguished in immediate contiguity with that part of the hyphal tissue which is below the apothecium. After reaching points perpendicular to the ends of the apothecium, this infra-cortical layer gradually passes into the hyphal tissue.

To elucidate the study of the asci and paraphyses, the section may be immersed for about half-a-minute in a 50% solution of hydrate of potash, which causes the parts to swell and separate. An aqueous solution of iodine is also useful for tinging the hymenium blue, and for testing the maturity of the spores, which will remain uncoloured if only in an embryonic state.

The specimen from which our illustration is taken was obtained by imbedding the lichen in paraffine wax, and slicing with a sharp razor. The section should be floated (not lifted) from the blade, and kept in lukewarm water, until all air is eliminated from the tissues, when it may be mounted in glycerine jelly.

EXPLANATION OF PLATE V.

a. a.—The Cortical layer.
b. b.—The Stratum-gonidiale.
c. c.—The Medullary layer.

Drawn by Arthur J. Doherty.

Thymol as a Polariscopic Object.

BY DR. T. S. RALPH, VICTORIA.

THYMOL, said to be a product of the Labitor, is a most splendid polariscopic object. In the first place, I beg to say that Thymol is really a purified product of an umbilifer of India, and goes into the market as *ajowan*. If a very small piece of Thymol, about the size of a mustard-seed (or perhaps two).

is placed at the edge of a covering-glass on a slide (not under), and then made to melt, it will run under it in a very fine film and crystallise on cooling. But before this takes place, it should be placed on the stage of the microscope, with the polarising apparatus ready, so as to watch the process of crystallisation. I consider the effects far exceed that of most polariscopic objects. The same specimen carefully re-melted can be used over and over again. If the Thymol is allowed to crystallise in a dense form, some fine combinations of crystals can be obtained; but I greatly prefer the thin plates under the cover.

Half-an-Hour at the Microscope,
With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

PLATES 6, 7.

On Placing Slides into the Boxes.—In other societies, on a member bringing forward a specimen, he enters into a description of it, with more or less detail:—how it was obtained, and where; how prepared; draws attention to the peculiarities of structure presented; their adaptations; the observed connections with related objects; notes follow on anything of interest and mode of life; finally, sketches are presented, which in all well-regulated societies eventually make their appearance in "Proceedings" or "Transactions" for permanent record of work done. I have sought to show how the thing should be done. The more nearly our proceedings approach to those of other societies, the more stable and satisfactory will be our progress. We *must* seek to have a permanent record of our work, and by each putting his shoulder to the wheel this will in time be secured.

[This was written in 1875. Mr. Tuffen West's wish for a permanent record has been attained.—EDITOR.]

Oak Branch (trans. sec.).—Good slides may be made by taking the piece of branch fresh, slicing it just as it comes from the tree, putting it then and there into glycerine, and after a time, when this has thoroughly penetrated, sealing up. For vegetable tissues, glycerine has no equal. Sections which I have had lying by me

for years, on being turned to when required for studying some particular subject, have delighted me by the clearness with which the structures entering into their composition were revealed. The simple explanation was that a slow process of penetration, and thereby of improvement, had been all the while taking place. It must be ever borne in mind that the object of an investigator is, and always must be, to see things (as nearly as possible) *in their natural condition.* By the simple mode given above, we obtain this. The soft cellular tissue of the liber in its different layers, the liber-fibres, the starch, if present, the exact degree to which organisation has taken place in the colloid substance, situate between and separating the bark from the wood (cambium)—all, all are preserved, and can be studied at any future period; for, *humanly speaking*, any length of time. The advantage of this can only be appreciated by those who have tried it. 'Tis like a thoroughly good book, which you read through and through and through again, and each time you come to it something fresh and true and delightful is found. Ponder these remarks.

Testis of Mytilus edulis (tr. sec.).—I have often speculated upon the early stages of the Mussel, especially when viewing the tiny, delicate, semi-transparent, hirsute little things at a stage which must be not far removed from their birth, and wished to look into it, but have never had any special call to, and so the desire has had to remain ungratified. Mussels, *I believe*, are not difficult to keep in small aquaria, so that by obtaining some when spawning-time was on, their study with a microscope might be made a delightful source of mental recreation.

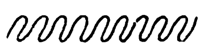
Young Ticks from New Forest (Pl. VI.) (found at Shirley Holms in the New Forest by a young lady to whom they were offering unwelcome attachment.—A. NICHOLSON).—Happy Ticks, to have found so skilful an embalmer! Happy lady! to have had the courage to bring them so cleverly to our friend, Mr. Nicholson! When beating for spiders with the Rev. O. P. Cambridge near Blandford, in Dorsetshire, some years ago, it was not an uncommon thing for young Ticks to be found in the "net," *an inverted umbrella*, along with multitudes of other "small game." And I have now and then found them about my person after a stroll "naturalising" on Frensham Common. In the young state they run with great rapidity, but once affixed they become most sluggish creatures. Their habits are most peculiar. You will remember the old tale of the Glutton? How it would ascend a tree, remain motionless on a branch till its prey passed, then drop on its victim's neck, and there remain till it loosed its hold from the helplessness of utter repletion. This, though said now to be (in great part at

least) mythical as regards the Glutton, is the literal fact with the Ticks.

I believe they cause no irritation by their bite, for I remember one being found behind the ear of one of my schoolfellows, which, from its size, it was supposed must have been on him two or three weeks at least, and he all unconscious till it was discovered by the merest accident. These specimens appear closely allied to *Ixodes ricinus*, the Dog-Tick. On comparing them again, since writing the above, I feel more in doubt about it. The members will have the power of judging for themselves, so far as drawings can help them, if they will compare Figures 1, 2, on Plate VI. It must be remembered that this is an *immature* specimen. The Dog-Tick had arrived at full maturity. There is a Tick that attacks Deer. This I do not know, but should like much to see. Perhaps by making love to some of the keepers at Greenwich, Richmond, or Windsor Park, specimens might be procured. The antenna-like organs are called "*palpi*"; the lateral portions of the rostrum, denticulate at the apex, are supposed to be "*mandibles*"; and the middle part, with its numerous recurved barbs, is taken for a "*labium*." But these determinations are confessedly uncertain, and would require much careful study of linking forms, as also of development, ere the homologies can be taken as satisfactorily settled. A member seems to have made a mistake through not having had the opportunity of studying the creature in life, and to have taken for a claw what is really a beautiful instrument of adhesion—an "*arolia*," or sucker (see Fig. 5). Another point worthy of careful note is the excavation of the apparently terminal joint of the limb (but which is really the penultimate) for reception of the claws. This is very noticeable in *Argas*, and still more so in the Scarlet Earth-Mite, *Trombidium holosericeum*. It has been remarked that the Ticks are blind. How, then, do they find their prey? Ah, how little do we know of these wonderful things! I remember Rymer Jones quotes the beautiful expression of an Italian philosopher, when trying to explain how it is that some of the humbler organisms come towards the light, though without visual organs, and so carefully avoid knocking against each other in the mazy dance, that they appear *palpare lucem*. Little more can we say with regard to the Ticks, than that they must have some compensatory sense highly exalted—smell, I should judge, if allowed to guess. The mandibles (?) are retractile, as, indeed, is the entire rostrum.

One at least of these specimens appears to show them in a very beautiful manner, *within the carapace*, which to myself is quite new and very interesting. Put on the highest powers to make out the beautifully delicate granulations on the dorsal shield, to which we must perforce give the technical name—*pro-meso-* and *meta- notum*,—

the three dorsal portions of the thorax fused into one for support of the limbs. There is no corresponding sternal plate. The delicate, beautifully undulating lines are folds of the skin, whereby the creature is enabled to expand from the size of a pin's head to that of a Horse-bean without inconveniencing itself. Imagine this



a section through part of the skin of the back; if it could be pulled out, how greatly extended a surface it would cover! or, better still, take half a sheet of foolscap paper, and fold it into half-inch widths lengthwise; see into how little compass it will go, and then draw it out; does it not excite involuntary astonishment that so extended a surface could be got into so small a compass?

Glass larva (Pl. VII., Fig. 1).—A popular account of this by E. Ray Lankester will be found in the *Popular Science Review* for Oct., 1865, p. 605, and Professor Rymer Jones read a paper on it before the Royal Microscopical Society, on June 2nd, 1867, which will be found at p. 99 of the *Quarterly Journal of Microscopical Science* for October of that year (Trans.). The Professor's account has his usual charm of graphic style. "There are many points," he says, "of high physiological importance susceptible of solution by a careful examination of this insect in its different stages of growth, which in other species would seem hopelessly beyond research, owing to their dark hue and the general opacity of their integuments; whereas the Glass larva, as it is not unfrequently called, seems eminently constructed for the purpose of courting our observation, inasmuch as it might almost be regarded as purposely intended for inspection—*one of those peepholes left by Providence, through which a glimpse may be obtained of the elaborate machinery of creation.*" (The italicising is my own.) The account has, however, a failing common to the Professor's writings, of over-highly wrought, sensational descriptions; as, in speaking of the parts of the mouth, he must have it that there are "*formidable* fangs," "*deadly* apparatus," "to pass the victim easily along the *deadly* road," and the like. Could the poor insect see the veteran Professor sitting down to demolish his chop, methinks it might retort with more reason on the knife, fork, and other truly formidable weapons he used in the process. The Professor's attention was specially directed to the endeavour to ascertain *how the metamorphoses took place*, from a creature breathing at the *tail*, to one breathing just behind the head, with, however, but partial success.

The fan-like hairs appended in pairs to each segment have been described by Huxley (after Leydig) as "peculiar sensory organs, articulated with a catch and spring" (see the article, "*Tegumentary Organs*," in Todd's "Cyclopædia of Anatomy and Physiology"). The larva is said to feed upon the Water-flea,

Daphnia pulex. The parts of the mouth are rather after the type of a Crustacean than of a Dipterous Insect-larva, and some amusing speculations might be indulged in as to the way whereby, according to evolutionist fancies, the Insect-larva's mouth had become modified towards a Crustacean type through feeding upon Crustacea!

There are two pairs of curious floats—one pair in the anterior third, the other near the tail.

Rymer Jones found no possible way of mounting this object but by putting it up in a cell with *pure water*, *alive*, sealing up at once with a margin of gold-size. In this way, they had been preserved by him for twelve months, "improving for some time," as he says, "by keeping."

Syritta pipiens, ♂.—In glorious Westwood we read (p. 559, Vol. 2):—"The larva of *Syritta (Xylota) pipiens* has been found in horse-dung by De Geer; it is thicker in front than behind, with a small point on the head," and in the Generic Synopsis at the end of the book (p. 136) that Meigen gave it the name of *Xylota.* There is but one species in this genus. It was called by Linnæus *Musca pipiens.* Horse-dung is easily procured, interesting larvæ occur in it, examine them carefully in the live-box or live-trough in the living state; if you have only one or two, draw and describe them carefully, then put them back again to breed out; watch them, and look for the puparium (pupa-like condition; it is not a true pupa, but the skin of the larva becomes hardened and horny), draw and describe this again in different aspects, and put carefully back as before. Then, with a little more patient watching, one day you'll see the fly; examine, describe, draw, and if a female, try to get her to lay eggs, and you have the life-history nearly complete. But not quite; for if so fortunate as to get several, you may have the opportunity of witnessing the union of the sexes (a very important point). The chapter may now be closed. You will for some time have had a most interesting and instructive study before you, and will be able to furnish a valuable paper for the "Transactions" of our own Society, which I hope some day to see published.

Claws of Insects.—In **Notonecta glauca** we have a typical illustration, and a most interesting one, of the truth that the claws of all insects, whatever form they assume, are *but modifications of hairs!!* to adapt them to special purposes.

Leg of Dytiscus.—*Dytiscus* is a great predaceous Water-beetle; the largest our country produces. To enable it to overcome the struggles of its powerful partner in the slippery element, the males have the three proximal joints of the anterior tarsi greatly dilated and furnished with sucking discs. The present specimen shows

the under-surface of the right tarsus and tibia. By turning it over, the three joints, in which so unusual an enlargement has taken place, may be well seen. A few thoughts on the arrangement of the suckers will not be without interest. We find, then, in the first place, two very large ones, the greatest size by far being with the inner one. On the joint bearing these are 40 more—*i.e.*, $2 \times 10 \times 2 = 40$; the second joint has also 40, $2 \times 10 \times 2$, again; the third joint has 60—*i.e.*, $2 \times 10 \times 3 = 60$. The two distal tarsal joints have nothing very special about them (as we say). The limbs of the second pair in the male *Dytiscus* are also furnished with a beautiful apparatus of sucking discs, the arrangement of which, however, I have not counted.

Tongue of Rhingia (Pl. VII., Fig. 3).—This compares instructively with that of Drone-fly, to be found in most cabinets. "The proboscis is long, membranous, elbowed near the base, terminated by two large labial lobes (under lip), and enclosing in a channel on the upper surface four setæ, viz.:—a long, horny, upper lip, hollow, and notched at the tip (labrum); a pair of slender, acute maxillæ, and a slender, acute tongue; at the base of the maxillæ is also attached a pair of small, inarticulate palpi, thickened at the tips." Is it not a beautiful description? It would not be possible to put it into different or fewer words without loss or injury. It is from Westwood, Vol. II., p. 556. Then we read, "These insects are either of a moderate or large size, and generally of variegated colours; they are very, very numerous; many species so much resemble humble-bees, wasps, and other Diptera, that they are constantly mistaken for them by the inexperienced. In one genus, *Volucella*, this similarity to the humble-bees is of eminent service to the insects, which deposit their eggs in the nests of those bees, an admirable provision of nature, since, as Kirby and Spence observe, "Did these intruders venture themselves among the humble-bees in a less kindred form, their lives would probably pay the forfeit for their presumption." Truly, the ways of God are past finding out. Yet are we permitted to see a little of them, and admire that we may love.

My attention was caught in crossing Frensham Common the other evening by what looked vastly like a humble-bee, yet was there somewhat of difference in the flight, the mode of settling down, and slowly hugging the heather-bloom. I felt sure it must be what I had been so earnestly desiring to obtain—a *Volucella*. I succeeded in capturing it, and bore away my prize with great delight.

There are but five species in the genus, so any individual can easily be named. Now, look you! these flies are so much like humble-bees, that the bees themselves appear unable to see the

difference. But "*Ex pede Herculem!*" which we may paraphrase, "By their feet ye may know them." There is a Dipterous kind of foot, a Neuropterous type, a Lepidopterous type, a Hymenopterous type, a Coleopterous type, and so on, which he who runs may read, after going to school long enough, and being sufficiently diligent therein. And all this opens out new and ever-increasing sources of mental enjoyment and enlightenment.

The Zebra Hunting-Spider—Salticus scenicus, ♂.—What a treat it was to us, as boys, to watch these fellows on the steps leading up to our father's warehouse, in dingy, smoky, sooty Leeds! So clean, and nice, and pure they looked, so agile and graceful in their movements, and panther-like in their spring! Little did I then dream that I should ever come to live near White's Selborne, to love the things he loved, to watch the things he watched, to examine the things he examined, only with the microscope in addition, to open wide the portals of knowledge, which to him, without that aid, were but as a sealed book! To claim as a friend the present proprietor of what was then the quiet vicarage; to see the letters which he wrote; to handle the stick wherewith he walked, and on which he leaned at times to muse and contemplate the lovely scenes before him. Great indeed is the power of genius! Well may his editor say, "When a beam of light shines forth in darkness, it throws its brightest rays on the objects nearest to it, while objects at a distance are scarcely illuminated at all. But the light of genius is of a different character, for it often happens that he whose brilliant intellect throws light on the darkened minds of men over the whole surface of the earth is unknown to those immediately surrounding him, and is even rendered the subject of contemptuous pity by those whose mental vision is no more capable of receiving the light of his intellect than their corporeal vision of enduring the glory of the meridian sun."

So it was with White. He was widely known as a philosopher in the highest sense of the word, but he was so known only to the world without. His own village could not understand him, and little did its inhabitants suppose that that insignificant little Selborne should become a world-known name by means of him, whose peaceful life was spent in retirement, and whose only eulogy from a surviving fellow-parishioner was, "That he was a still, quiet body, and there wasn't a bit of harm in him; there wasn't, indeed." (Routledge's edition, 1854, ed. J. G. Wood).

The falces are so different in the male from the female. In the former the palpi are longer and larger, and it would seem that to enable it to take its prey a corresponding lengthening and strengthening of the prehensile portion of the mouth-organs was necessary. The palpal organs, being small and simple in *Salticus*,

do not present to the eye such a striking appearance as do those of *Epeira diadema*, figured in *Science Gossip*, Vol. 1871, p. 86. The structure of the claws, spinnerets, and scopulæ (brush-like appendages to the feet, whereby they are enabled to run rapidly over smooth bodies in quest of the flies on which they feed) may well engage our attention.

The nature of the hairs clothing their limbs, tactile and segmental, and also the scales (so peculiar and interesting in their structure), with which the thorax especially is covered in life, is well worthy attention.

I would commend to our members the study of the palpal organs. If they can be examined unrolled, they solve to my mind the difficulties which had presented themselves as very serious to the reception of the belief that the palpi of male spiders really were the sexual organs, viz—their apparently small size; where is the prostate gland to be lodged? where the vesiculæ seminales? where the testes? After seeing what I have recently, this difficulty, presented by their wonderfully close packing together in the hollow of the last digital joint, was removed. There is evidently abundant room. The enquiry, however, into the exact anatomical conditions is a difficult one. The parts are so minute, require time in dissection which I have not to give to it, and higher powers than I possess (1,200 to 1,800 or 2,000 diameters), whilst I cannot go satisfactorily beyond 500.

In a paper published in the *Monthly Microscopical Journal*, Alfred Saunders described and figured the spermatozoa of certain of the *Crustacea* and *Arachnida*.

John Blackwood's communication to the 14th meeting of the British Association for the advancement of science, held at York, in Sept., 1844, was published in the volume for 1845. In this, at pp. 67—69, are detailed experiments which set the question at rest for ever, and prove beyond the shadow of a doubt, from direct experiments repeated with the utmost caution, that impregnation takes place *solely by contact of the palpi with the female genital organs.* I have myself repeatedly seen sufficient to satisfy me of the accuracy of this, so thoroughly, that I do not even care to repeat, unless I could extend them.

My dear lamented friend, Richard Beck, had also satisfied himself, from close observations, many times repeated, that it was as above stated. Another valued and much-mourned friend, J. W. Salter, a patient, accurate, acute observer, had also, I found in conversation, come into possession of facts to the same purport, from direct observation. They rest from their labours, and can speak but through me. Popular authors have little time for direct observation; they are, and must be, for the most part, "*book-makers.*" They receive their metal from others, stamp it

with their own die, and then pass it on. They have their favourite authors, old and respectable, with whom they throw in their lot—their prejudices, mayhap. They may think it does not suit them to recognise young and rising men, their own rivals, and so Truth stands still, till Time has done its work, and Truth stands out at last, clearly revealed.

Nomenclature.—As to the name of a certain Diatom, I don't care two straws about. If, as is admitted, Smith was the first to describe it correctly, his designation must, by the laws of Priority of Nomenclature, stand. I don't know how far our members are acquainted with the proceedings which took place to settle the laws that were to regulate for the future the question of Priority of Nomenclature. They are briefly as follows :—

Some years ago the whole subject was in a state of chaos. The incessant hair-splitting of some observers, the description of objects from imperfect observation, without any pains taken to trace out their life-history; the multiplication of books describing the same thing by different names, according to the fancy of the author, made it imperative that steps should be taken to put a stop to such a serious and rapidly-growing evil. The matter was brought before the "High Court of Parliament for Science," the British Association. Much consideration was given to it, and a committee of men, the most eminent for their scientific attainments, was appointed, which drew up a few brief and simple rules that should ever after regulate the subject. If an author *described an object in brief, simple terms, whereby it could be recognised by other competent observers, the name bestowed by him upon it must be accepted.* A thorough overhauling of scientific nomenclature followed; old authors were hauled through, and if on mature consideration it was agreed that they had complied with the conditions stated, their names took precedence, and we had all to go to school again, to learn a lot of (to us) new names for objects, well and familiarly known the world over by names in some cases much more appropriate. I remember the name of *Anguinaria anguina* as a case in point. The name is singularly appropriate and picturesque, but somebody, most likely Ellis or Lamarck, had called it long before by another name, which, upon my word, I could not tell without looking up, and by that name it now goes, the canon having been sufficiently complied with. I remember well remonstrating with Busk about it, but the laws are as the laws of the Medes and Persians—inexorable, and it is no use for anyone to attempt to alter them, however much we might wish to. Waiving altogether the question of the superior descriptiveness of the name, *Scoliopleura tumida*, still the canons are laid down, and MUST be abided by. Having received personal civilities from

Prof. Grunow, I should perhaps be the more disposed to prefer that the better name should stand, but it cannot be. The question will not be without interest to many of our members, and will be found in volumes of the British Association Reports, which, doubtless, they will be able to consult.

TUFFEN WEST.

EXPLANATION OF PLATE VI.

Fig. 1.—Rostrum of Mr. Nicholson's Tick from New Forest.

,, 2.—Rostrum of "Dog-Tick," *Ixodes Ricinus*, from specimen lent by H. E. Freeman:—*m.m.*, mandibles (?); *l.*, labium (?). The latter specimen has been greatly injured, evidently by forcible removal from the animal on which it was found.

,, 3.—Antenna-like "Palp," from the Forest specimen, left side, seen on its under-surface.

,, 4.—The same part from the Dog-Tick. The extreme thickness of the bony integument will be noticed; it is finely laminated like a lobster's claw. There are also channels through its thickness for enabling nerves to communicate with the surface; an appearance frequently met with in the horny integuments of the *Insecta*.

,, 5.—Foot of "Tortoise Tick," drawn from a living specimen. *a.*—A beautiful sucker, called an "*arolia.*" In mounted specimens, the lateral halves of this are usually placed together so as, on superficial inspection, to appear like a claw.

Drawn by Tuffen West.

EXPLANATION OF PLATE VII.

Fig. 1.—This figure represents the slide of Glass Larva (*Corethra plumicornis*), which is preserved so as to show beautifully its serpentine appearance. This has been pointed out by Westwood.

e., Eye.

o., Ocellus. So far as I know or remember, it is the only larva having just such an arrangement of visual organs, viz.—Compound eyes and ocelli.

u.d., a mass of undigested food.

a.f., Anterior pair of floats, analogous to the swim-bladders of fish.

p.f., Posterior pair of floats. The floats in life are much

more conspicuous than in the mounted specimen, being densely covered with black pigment.

***sh. sh. sh.*, Sensory hairs.**

***v*,, Vent, which opens out between the four leaf-like processes.**

The numbers indicate the different segments.

Fig. 2.—Fan-shaped hairs, more enlarged.

Drawn by Tuffen West.

,, 3.—Tongue of *Rhingia* Fly.

Drawn by F. B. Kyngdon.

Selected Notes from the Society's Note-Books.

PLATE 8.

Mite from Pheasant (Pl. VIII., Fig. 1).—This, although found on a Pheasant, is not a true bird-mite, but belongs to the third division of Hermann's Trombidiums, and is characterised by having the eyes superior, and the anterior and posterior pairs of legs longer than the others. There are a considerable number of these mites found in moss; they are more or less red, and have two bright sealingwax-like eyes between the first and second pair of legs. Koch classes them under the name of *Rhyncolophus*. Most of these mites are very beautiful when alive, and some of them are rather large.

C. F. GEORGE.

White Mites (Pl. VIII., Fig. 4).—In June, 1877, I noticed a black poplar tree suffering from the ravages of insects. In many places it was bored by the larvæ of the Goat-moth (*Cossus ligniperda*). On removing a portion of the bark, which was wet and loose, I found it covered with a moving mass consisting of myriads of very peculiar White Mites. When I examined them under a microscope, I found them to differ from any mites I had ever seen before, nor could I find a notice of any similar mites in any books to which I was able to refer. The females, which were in the greatest abundance, were egg-shaped, the larger end being in front, and the sides, towards the posterior, somewhat bent in. On slightly compressing them, they were seen to contain eggs; and on crushing one, several young ones escaped from the almost mature

ova. These had only six legs, one of the hinder pair being missing (see Fig. VI). The abdomen of the mature female was of a milk-white colour, and the legs reddish-brown.

The males, which, compared with the females, were few in number, were very peculiar in appearance. Their bodies were smaller and flatter, and their legs longer and stouter in proportion than those of the females; the posterior pair were not used for walking, but stretched out backwards, their extreme ends bent inwards, and, as far as I could make out, not furnished with claws. Their gait was extremely awkward.

I visited this tree again in the middle of August, when I found a number of *Hypopi* (see Fig. 5) with the White Mites, but whether they were parasitic on them, or merely residing with them, I was not able to determine.

C. F. GEORGE.

It would be interesting to know what are the lateral oval markings shown in the figures illustrating the above paper. The slide now exhibited bearing this name is labelled *Tyroglyphus rhyzoglyphus*, but I cannot quite reconcile this with the only notice of these creatures I have by me, viz. :—Packard's Guide to the Study of Insects, where, in a section devoted to the Arachnida on p. 665, 6th edit., he says :—"The genus *Tyroglyphus* is known by the body being elongated oval, with scissor-like mandibles, and outstretched four-jointed feet, with a long, stalked sucking-disc at the end."

The sucking-discs, at all events, I cannot make out, either in the slide or in the figures in *Science Gossip*, above referred to.

A. HAMMOND.

Larva of Corethra (Glass Larva).—I have just looked at a specimen which I put up in water two years ago as recommended by T. Rymer Jones, in his admirable paper in the *Quarterly Journal of Microscopical Science* [cir., 1874], and find it looks nearly as fresh as when first put up. But I do not anticipate "fixity of tenure" for it; I fancy a little external violence would disintegrate the specimen. A good description of this object will be found in Lardner's "Museum of Science and Art" (chap. 3, pp. 90—94, on Microscopic objects), and he gives reproductions of Dr. Goring's drawings of the larva and pupa; also of the image and eggs. I well remember the pleasure I experienced in first taking a specimen and examining it with the very poor micro-

scope I then used. I have since found it in abundance in some still water at Wood Green.

H. E. FREEMAN.

It is almost impossible to mount this beautiful larva in such a way as to give any idea of its appearance when alive. In its living state, it is one of the most curious and interesting of aquatic larvæ, and is so transparent that were it not from its dark-coloured glands it would be very difficult indeed to find. Dr. Carrington gives a full account of it, amply illustrated in *Science Gossip*, Vol. 4, p. 78, etc.

ARTHUR COTTAM.

This object should have been mounted in glycerine.

H. M. J. UNDERHILL.

I have been fortunate in finding the beautiful "Skeleton larva," *Corethra plumicornis*, at Wood Green. A gentleman exhibited at the Quekett, in 1874, a specimen of this larva mounted in the act of changing to the pupa. Lardner says the larvæ are very scarce, and must not be fed in captivity if it is desired to keep them in the early and more beautiful stage; but my experience does not confirm this, and even a plentiful supply of Daphnia, etc., did not appear to accelerate the transformation, which, in fact, occurred very seldom in my "aquarium"—*i.e.*, a bottle of water. I kept some all the winter, and they thrived and grew considerably. The plan recommended by Rymer Jones for mounting—viz., plain water and closing with gold-size, answers admirably. I have one mounted nearly a year, which looks almost like life. I think the larva very large for so small a gnat.

H. E. FREEMAN.

Dermaleichus passimus.—The greatly developed third pair of legs, and the rudimentary condition of the fourth pair, afford an illustration of the general law, that excess of development in one portion of an organism is accompanied by arrested development in the neighbouring parts.

A. HAMMOND.

Uropoda vegetans (Pl. VIII., Fig. 3).—Some years ago, while examining a small species of *Carabus*, I found one covered with a curious parasitic mite, attached by what appeared to be a chitinous rope to the beetle. I made a drawing of it, as also of some others, which I found free, running about under the elytra. A copy of these drawings I annex. I did not at the time know what the tailed species was, but was afterwards informed that it was *Uropoda vegetans*. The drawing was from the living mite, and does not show those details which are revealed by the mounting in balsam. Is it possible that the free species were the immature forms of the other? Packard says that the Acarina, when first hatched, are worm-like; then there is an oval stage, when the young mite has but three pairs of feet (though in others at this stage there are four pairs), and after another moulting the fourth pair of limbs appear." The passage in brackets would leave room for such a supposition. I think the peduncle is solid and not tubular, as Mr. Nicholson suggests; but perhaps he may be right, as he says he has compared it with others. I cannot imagine, if this be a part and parcel of the animal, what portion of the animal it can represent. I have hitherto regarded it as a secretion somewhat analogous to the byssus-threads of a mussel, but in the slide before us, it presents all the appearance of being composed of chitine, the same as the rest of the horny structures of the animal. If it be a portion of the body, how is the attachment effected? How comes it that this creature is found on the petal of a geranium (as stated by the owner)? This would appear to be far from its usual habitat.

A. HAMMOND.

I am desirous of knowing what are the uses of the tail appendages of this mite, and what is the substance at the end of each?

From a careful consideration of somewhat similar specimens in my possession, in various stages of development, I have little doubt of the tail appendages being tubes, acting in the double capacity of means for suspension, and of passage for nutriment, a perfectly-formed aperture being visible when the tail is gone. My specimens are fixed to the elytron of a beetle.

A. NICHOLSON.

The slide containing this object also contains a young mite, not fully developed, which also shows a peduncle.

A. ATKINSON.

I think Mr. Nicholson is wrong in considering the tail-like

process of *Uropoda vegetans* to be tubular. I have known this creature to form the appendage and attach it to a glass slip; it is, therefore, undoubtedly, a secretion, and can be formed by the animal at will. I have frequently found them under stones without this appendage. In Mr. Hammond's figures the upper one is a *Gamasus*, and therefore not the immature form of *Uropoda*. I have met with several forms of *Uropoda*, but do not know whether all of them form the appendage.

I look upon Hermann's *Notaspis Cassidens* as a form of *Uropoda*, and although Koch describes several kinds of *Notaspis* as if they belonged to the *Oribatidæ*, yet I think that all of them belong to *Uropoda*. I have found several of his species, but think I have seen none of them, except *U. vegetans*, produce the tail-like process.

C. F. George.

Spiders.—Let students of these interesting creatures examine them whilst living; at the same time, refer to Van der Hoeven, Vol. 1, p. 565, and Siebold and Stannin's Invertebrata, p. 309. They will then learn what is known on a highly interesting subject, and if they are actual workers will be able to add much to the stock of valuable knowledge.

Tuffen West.

Prof. Owen's Hunterian Lectures, p. 462, says:—"The most careful observations, repeated by the most attentive and experienced entomologists, have led to the conviction that the ova are fertilised by the alternate introduction into the vulva of the appendages of the two palpi of the male."—Fourth edition, 1855.

Rymer Jones, fourth edition, 1871, dedicated to Prof. Owen, says, p. 414:—"The impregnation of the ova is evidently effected by the simple juxtaposition of the external orifices of the two sexes;" giving us the use of the palpal organs, "most probably as an exciting agent, preparatory to intercourse."

D. Moore.

Palpal Organs of Spider.—I cannot refrain from saying a word or two. Dugé's very reasonable idea that these organs are used by the male for collecting together and keeping his spermatozoa ready for use, receives no refutation from Mr. Blackwall (whose interesting paper I have read), and, I think, falls in with other observations, as to the absence of direct communication between

the palpal organs and the vesiculæ seminales, and the presence of vesiculæ seminales, in the part usually ascribed to them, is, I think, beyond doubt.

D. MOORE.

Cutting Glass-Circles.—I cut my own circles, trough-covers, etc., and find no difficulty in doing so. I use some perforated wooden slips of suitable size, procured at any optician, and run the writing-diamond round the aperture. Any smooth hole will answer, or even a card with a hole punched in it will do, but soon wears rough. The thin glass must be well supported; a piece of plate-glass is best to rest it on. The diamond should have a *turned* point, and not a mere splinter. Very little pressure upon the diamond is necessary; too much will make a rough scratch, when the glass will not break evenly. It is well to leave the circles a day or two before breaking them out of the glass; they come out much better than if just cut.

H. E. FREEMAN.

Polariscope objects, with few exceptions, are merely pretty things, well enough calculated, in moderation, to relieve the solid bill of fare at a *soirée* or conversazione, but nothing whatever is to be learnt from them save that by certain arrangements of apparatus belonging to our microscopes, some things become decked in gay colours; that is literally all.

TUFFEN WEST.

EXPLANATION OF PLATE VIII.

Fig. 1.—***Rhyncholophus phalangioides*** **(*Trombidium phalangioides*, Herm.), from Hermann's figure, copied from "Economic Entomology," and is supposed to be the *Acarus phalangioides* of Degur, which occurs under the bark of trees in the forest of the Ardennes. The magnification is not given.**

,, 2.—Gamasus found with

,, 3.—Uropoda vegetans.

Drawn by A. Hammond.

,, 4.—Female of White Mite, × 72.

,, 5.—Hypopus, found with the White Mites, × 72.

,, 6.—Young of White Mite, × 72.

Drawn by C. F. George, and copied from his article in "Science Gossip," Vol. 14.

Our Annual Meeting.

THE Tenth Annual Meeting of the Postal Microscopical Society was held in the Prince's Salon, at the Holborn Restaurant, on Thursday evening, the 11th of October.

Mr. A. Hammond, F.L.S., President, was in the chair, supported by Dr. C. F. George, in the vice-chair. The names of the ladies, members, and friends who were present were as follows; the visitors' names are distinguished by an asterisk:—Miss Allen,* Mr. S. R. Barrett, Mr. G. H. Baxter, Mr. E. Bostock, Mr. Geo. D. Brown, Mr. W. H. Burbidge, Mr. Richard Carter,* Mr. F. W. Cooper, Mr. F. C. Cox, Mr. Chas. Clarke,* Mr. Thos. Curties, Mr. George Dannatt, Mr. M. Farhall, Mrs. Farhall,* Mr. H. E Freeman,* Mr. C. F. George, Mr. Harry George,* Mr. F. George,* Mr. J. W. Goodinge, Mr. N. Gregory,* Mr. Arthur Hammond, Mrs. Hammond,* Mr. Romyn Hitchcock,* Mr. George Looseley, Mr. F. Martin, Mr. J. Martin,* Mr. E. Maynard,* Mr. J. W. Measures, Miss A. B. Newman,* Dr. H. F. Parsons, Mrs. Parsons,* Mr. R. Peach, Mr. F. E. Robinson, Rev. E. T. Stubbs, Mr. Washington Teasdale, Mr. Alfred Allen (Hon. Sec.).

At the close of the dinner, the PRESIDENT proposed "The Queen," which was heartily received.

The business of the Annual Meeting was then proceeded with. The Report and Balance Sheet, copies of which had been sent to the members and distributed to those present, being taken as read, were adopted. The following is a copy:—

"THE Committee have much pleasure in laying before the Members of the POSTAL MICROSCOPICAL SOCIETY their Tenth Annual Report, and in doing so beg again to congratulate them on its sustained and increasing success.

During the past year the Sub-Committee have held six meetings; others would most probably have been held, but for the illness of your Hon. Secretary, which not only confined him to the house, but prevented his taking any active part, except so far as was absolutely necessary, in the work of the Society.

Shortly after the Annual Meeting all slides in circulation were exchanged, and an alteration was made, in compliance with the suggestions from some of the Members, in the size of the MS. Note-Books: this alteration has proved in working to be very inconvenient, and it is now proposed to adopt a more convenient size of book immediately after the present Meeting.

At the date of the last Committee Meeting (Sept. 3rd), the total number of enrolled Members was 170; during the past year 29 new Members have been added, while a few have found it necessary, from various circumstances, to resign.

With feelings of very sincere sorrow, your Committee have to record the death of Col. Basevi, of Prestbury, near Cheltenham. The late Col. Basevi had been a member for many years, during the whole of which he took a warm and untiring interest in the welfare and success of the Society. The slides circulated by him were always of a peculiarly interesting character, his notes were always carefully and thoughtfully written, and his drawings and rough sketches were effective, and thoroughly explanatory of the subjects treated. An unfinished drawing appears in one of the note-books, testifying how great an interest he retained in the Society to the last.

Another member, Dr. J. Kendall Burt, of Kendal, had temporarily resigned in consequence of a severe illness; he was recommended to take a sea-voyage, but we regret to learn he died on his voyage out.

Your Committee are again, with much reluctance, compelled to enforce on Members the need of greater punctuality in the despatch of P.M.S. boxes, and that this may be more effectually secured, they request each Member to keep in mind the name of the one preceding him on the list; and in the event of three weeks passing without the receipt of a box, the preceding Member should be written to, who, if the cause of delay does not rest with him, must then write to his predecessor, and so on; the Member so written to, should, after the lapse of fair and reasonable time, acquaint the Secretary with the delay, who will at once take all necessary steps to trace the offender, and the whole of the correspondence will be laid before the Committee at their next meeting.

Your Committee take pleasure in congratulating many of the Members on the superior manner in which they have employed both pen and pencil in the way of descriptive illustration of their slides during the past session, and trust that they will take advantage of the increased facilities which will be afforded to them in the future, to make their Notes and illustrations still more worthy a place in Our Own Journal.

It is with no small degree of gratification that your Committee are enabled to announce that the Journal of the P.M.S., which has just completed its second volume, is in a fair way to achieve the success so anxiously looked forward to by its promoters. As is the case with every new enterprise, a certain amount of difficulty has to be met and overcome, before the looked-for

prosperity can be attained. But that its permanent success may be speedily and effectually secured, its Editor very confidently appeals to all the Members of the Society, and to all Microscopists and friends of Science generally, throughout the kingdom: first, to promote its usefulness by the contribution of good and suitable articles; and second, to increase its sale by inducing as many as possible of their personal friends to become subscribers.

The following is a copy of the Balance-Sheet, which has been duly audited:—

The Postal Microscopical Society in account with Treasurer.

	£	s.	d.		£	s.	d.
To Postages ..	£36	14	7	By Receipts ..	£56	18	6
,, Letters surcharged	0	2	11	,, Balance	13	16	9
,, Journey to London attending Annual Meeting	2	0	0				
,, Two Visitors ..	0	8	0				
,, Dinner-Cards ..	0	3	6				
,, Christmas-Box to Postman	0	2	6				
,, Printing Reports, etc.	7	10	0				
,, Note-Books ..	1	10	0				
,, Envelopes	0	5	0				
,, Circulating Journals	6	2	0				
	54	18	6				
,, Bal. brot. forward	15	16	9				
	70	15	3		70	15	3

Audited this 14th Sept., 1883. R. H. MOORE.

The SECRETARY called attention to certain alterations, which, he hoped, would add very considerably to the more efficient working and the greater usefulness and permanent success of the Society. He thought that as the Society entered on its SECOND DECADE to-night, no more fitting opportunity would be found for making any important alteration than the present.

A few weeks ago, several propositions were submitted to all the members, and their views solicited. The list of proposed Rules laid before the members this evening embodied, as far as practicable, all the various suggestions received up to date, and were as follows:—

1. That the Society be divided into—

a, Fellows; *b*, Members; *c*, Honorary Members;

who shall each pay an annual subscription of 10s., and that each will be entitled to receive one copy of the Journal as published, and may purchase any further number at 5s. per year for every additional copy (except the price of the Journal should be altered, when the price to Members for additional copies will be three-fourths the retail price, *plus* postage). [This in no way alters the present subscription, as each member, with the exception of one or two, already subscribes for the Journal.]

2. That Fellows shall be elected at the discretion of the Committee from the Members at large (subject to the approval of the Members at the Annual Meeting); the qualification for Fellowship being the circulation of the required number of slides, with notes and drawings in illustration of the same. Lists of new Fellows to be prepared by the Committee prior to the Annual Meeting, and laid before such Meeting for its approval.

3. The Honorary Members are those who pay the annual subscription, but prefer not to see the boxes or to circulate slides. [We have several such now in the Society, all of whom subscribe for the Journal.]

4. That at those times when it shall be considered desirable to renew or exchange the slides (not being oftener than at intervals of twelve months), all Fellows and Members be required to send to the Hon. Sec. six good slides accompanied by notes, and when practicable drawings in illustration of the same. Suitable MS. books and drawing paper will be supplied by the Hon. Sec.

These slides will be arranged in boxes, and all slides then in circulation will be returned to their owners with the notes relating to them. Each Member will remove his own slide and send on the box and book to the next name on the list, the last Member to return the empty box and MS. book, &c., to the Hon. Sec. [For the efficient working of the Society, 5 slides are absolutely required from every Member; if therefore 6 slides are sent each box will be filled by two Members. By this arrangement it is also thought that the boxes will be more judiciously filled than is now sometimes the case.]

5. That all Members who are unable or unwilling to circulate any slides shall pay an extra subscription of 5s. yearly, when the Hon. Sec. will buy suitable slides and insert them in the boxes. [It is certainly unfair to those who circulate the full number of slides and notes that others should do nothing to advance the interests of the Society; and we think that few Members would value their slides and notes at so low a figure as 5s. the year.

Owing to the defalcations of some Members, others have been almost compelled to circulate many more slides.

6. All Members who circulate some, but a fewer number than six slides, may compound for the deficiency by paying 1s. 6d. each for the remainder, making six slides in all.

7. All slides purchased as suggested in Nos. 5 and 6 shall, at the expiration of their circulation, be transferred to the Reference Cabinet of the Society.

8. That Fellows and Members may Insure all their slides in circulation by paying an additional insurance fee of 2s. with the annual subscription, when in case of breakage the Hon. Sec. will replace to the best of his ability all slides belonging to such Member as may be broken in transit; but the value of no broken slide shall be assessed at more than 5s.; and all slides so replaced will be marked as such and will of course be the property of the original owner of the slide destroyed.

9. Members leaving home for any longer period than two days must either leave instructions for the box to be at once dispatched to the next name, or write to the Member preceding, and to the Hon. Sec.

10. Members keeping the boxes longer than four days, from whatever cause, must pay a fine of twopence per day, commencing at the 5th day. [This Rule is very much objected to, but no one suggests an amendment, except that all box-stoppers shall be "excommunicated." Who will suggest a remedy without resorting to such severe measures?]

11. The Vice-President of one year shall become President the year following, and that Presidents and Vice-Presidents be chosen from the lists of Fellows or Honorary Members.

The Secretary said he had received many letters containing suggestions, the most important of which he would read to the meeting. Several letters were then read, which are too lengthy for publication. The following is a summary of their contents:—

The first letter was from their young invalided friend, Mr. Searle, who was too unwell to be present that evening. He approved heartily of proposition No. 4, since it would increase immeasurably the efficiency of the Society, giving it, in fact, a fresh starting-point.

The Secretary further said there were 13 or 14 members in a certain circuit which he would not name. The majority were hard-working, valuable members. But one or two were shockingly negligent. He was frequently troubled with complaints as

to delay of boxes, and had to write many letters to offenders in that respect. On one occasion four boxes arrived together at the house of one member, and since then none at all had come to hand, although more than one was due. On this subject a letter had been received from the Rev. W. H. Lett, who suggested that all "box-stoppers" should be relegated to a special circuit consisting of themselves alone, and marked with the letter "Z."

On the suggested Rule 10, the Rev. C. H. Waddell wrote. He feared that the proposition would not work, and proposed as an amended rule, that members detaining the boxes unreasonably so as to cause inconvenience should be passed over in the circuit by direction of the Secretary, on information of their repeated fault being communicated to him.

Mr. Alfred Atkinson, the first President of the Society, wrote from Brigg, and said he thought that honorary members should not have a vote in the proceedings and working of the Society.

A letter was also received that evening, addressed to the President, from Mr. C. N. Peal, of Ealing, expressing complete disapproval of all the propositions.

Many other letters had been received, but as their views were embodied, as far as practicable, in the revised copy of suggested rules, it would be quite unnecessary to take up the time of the meeting in reading them.

The Secretary observed that he had little further to say, except that, as he had already stated, he had received a great many replies to the circular issued by the Committee. All contained suggestions which he considered more or less good, and he had tried, as far as possible, to meet the suggestions which had reached him up to that time.

A member, whose opinion he considered was worthy of attention, suggested that it would be unwise to designate members who pay a subscription "honorary members." He (the Secretary) was quite willing to abandon the term honorary, but thought that some of the best working members might with justice be raised to the dignity of Fellows.

With respect to the 4th suggestion, which related to the regular supply of boxes, he thought every member present had felt more or less the inconvenience of receiving back their slides without the notes, after going through every circuit. To keep up a constant circulation, five slides were required from every member, but a great many members did not put in five, and on the next circuit some good-natured friend would put one in to fill the box. That foreign slide would probably accumulate a great many notes, and in due course it would be returned to the sender, but without the notes. One reason why our valued member, Mr.

Beaulah resigned, was because he could not see the notes on the slides which he had circulated. It was impossible to send to each member all the foreign boxes into which they had put slides, and the only plan he could conceive of was to return such slides to the owners without notes. It was now proposed to give the members notice that they must forward to the Secretary six slides in two or three months' time. Some members would write many notes and make drawings, whilst others were unable or unwilling to describe their slides. If members did not send slides, he thought it only fair to the other members to ask them to pay a monetary equivalent. Whether the slides should be given to the members or placed in the Reference-Cabinet, he left to the meeting to decide.

The PRESIDENT invited the members to express their views on the proposed alteration of rules, adding, that it certainly appeared to him, that the proposal with regard to asking for a certain number of slides in the commencement of the year was worthy of their consideration and acceptance.

DR. GEORGE enquired whether, when six slides were asked for, six boxes would be sent to each member, or only one box for six slides?

The PRESIDENT remarked that point had occurred to him, and he asked if there would be any objection to divide the slides into batches of three each?

The SECRETARY said he presumed that many members would select slides that had some bearing on the same subject, thus forming a series.

DR. GEORGE considered that was practically making special boxes, as was done some time ago.

The SECRETARY further explained that he should ask for these six slides, two or three months before they were required. A member should at present send a slide once a fortnight. There would, therefore, be the same time allowed to prepare six slides as members had under ordinary circumstances by the unaltered rule. He believed that with the new arrangement things would be very much as at present. There would be some special boxes and some miscellaneous.

A lengthened discussion followed, in which Messrs. George, Brown, Parsons, Barrett, Teasdale, Goodinge, the Rev. E. T. Stubbs, and others, took part.

DR. PARSONS considered that one thing which appeared to interfere with the working and usefulness of the Society was, the members never saw the notes made upon their slides except those made on the first circuit. The notes certainly sometimes went round twice, but when they came to a member on a second or subsequent circuit, if some point arose on which the member

desired information, or to ask a question, there was no chance whatever of doing so.

The SECRETARY said it was this difficulty which he was most desirous of remedying, and which, he felt sure, would be remedied by the suggestion now under discussion.

DR. MEASURES enquired if an increase of members would necessitate a larger number of boxes? He also noticed that a box which had lately come round was designated by a letter and number, instead of a geographical distinction. He preferred the latter. He feared by the new arrangement they would lose a little of the spirit of emulation.

THE REV. E. T. STUBBS was not surprised to hear the last speaker refer to the boxes being distinguished by a letter, especially in view of the suggested formation of a "Z" circuit for offenders who delayed the boxes. He considered that was a very important suggestion. As to the notes, he very much objected to notes of a personal character.

DR. BROWN proposed that the report should be passed in the regular order. As to the proposed distinction of ordinary members, honorary members, and fellows, he thought they had much better remain as they were.

MR. TEASDALE asked whether the rules would be taken together or separately?

The PRESIDENT said it would be better to take the rules one by one in succession; whereupon

DR. PARSONS moved—"That the Society should consist of a single class of members as before." He did not see the necessity of having honorary members.

MR. CURTIES approved of one grade of members and all to pay alike. He seconded the resolution with great pleasure.

MR. BARRETT said, as to the distinction between "members" and "fellows," let honour be to those who deserved honour. He proposed—"That those who had passed the chair should be entitled to the honour of Fellowship."

The PRESIDENT put Dr. Parsons' resolution to the meeting, which was carried.

DR. BROWN wished to suggest that any member might inform the Secretary when he wished not to receive the boxes for a time.

MR. CURTIES remarked that the Committee permitted that at present. It was only necessary to inform the Secretary that they were non-effective for a time.

MR. TEASDALE said the previous resolution disposed of suggestions Nos. 2 and 3, and as to No. 4 it was not quite clear. He wished to know whether the slides the members contributed should be sent direct to the Secretary, or would boxes go round

for them? If they were to vote upon the rules, they should understand them.

The PRESIDENT said it was only necessary to strike out the words, "Fellows and."

DR. MEASURES proposed that those words should be struck out, and the rules otherwise stand as in suggestion 4.

THE REV. E. T. STUBBS seconded the resolution, which was put to the meeting, and carried.

MR. TEASDALE thought if they settled the general principle of the rule, Mr. Allen would listen to all the suggestions made and harmonise them. He thought Mr. Allen had shown a wonderful amount of intelligence and perseverance in trying to adapt the Society to the various requirements of the members. They had been looking at the slides from a contributor's point of view. But there was another point of view—the recipient's. Many members cared for little beyond their own specialty; others, especially those in remote country places, where they had little opportunity of seeing good slides, preferred variety. He had no distinct proposition to make, but he thought anything they should pass should be permissive and suggestive rather than obligatory.

DR. PARSONS moved "That each member pay an Annual Subscription of 10s., and be entitled to one copy of the Journal as published, and that he shall be entitled to purchase an additional copy for 5s. a year, subject to there being no alteration made in the selling price."

MR. COX seconded the resolution, which was put to the meeting by the Chairman, and carried in the usual manner.

DR. MEASURES proposed that Rule 2 should be—"That at those times when it shall be considered desirable to renew or exchange the slides (not being oftener than at intervals of twelve months), all members be required to send to the Hon. Sec. six good slides, accompanied by notes, and where practicable, of drawings in illustration of the same. Suitable MS. books and drawing-paper will be supplied by the Hon. Sec."

DR. PARSONS moved that suggestion 5 should be as follows:—"That those members who do not wish to circulate slides shall be allowed to receive the boxes on payment of 5s. a-year beyond their ordinary subscription."

DR. BROWN seconded the resolution, which was put to the meeting, and carried.

DR. BROWN proposed that suggestion 6 should be—"All members who circulate some, but a fewer number than six slides, may compound for the deficiency by paying 1s. each for the remainder, making six slides in all."

MR. COX seconded the resolution, which was duly put to the meeting, and carried.

Mr. Barrett proposed the adoption of suggested Rule 7.

Dr. Parsons seconded this, which was duly passed.

Mr. Curties begged to interrupt the meeting for a moment. Suggestions 8 and 9 were proposed, he presumed, for the convenience of the Secretary. He thought it was doubtful whether the adoption of such rules would be of any real advantage to him. At the same time he was sure the Secretary had sufficient knowledge of the work to advise members. He ventured to suggest whether they really required Rules 8 and 9.

The President said they would take Rule 10.

Mr. Curties remarked that although the rule was very much objected to, some plan might, perhaps, be suggested that would meet the case.

Dr. Brown thought that the proposed rule would be more trouble than it was worth.

The Rev. E. T. Stubbs proposed that the rule be amended thus—"That any member detaining boxes beyond the proper period shall be relegated to a circuit of such defaulters alone." It was necessary to hold a rod *in terrorem* over these members.

Dr. Brown seconded Mr. Stubbs's proposal, and thought that there must first be some repetition of the offence before acting on the rule; he would say, after being repeated three times.

The President put the resolution as proposed by the Rev. E. T. Stubbs and seconded by Dr. Brown, and the same was carried.

Mr. Goodinge thought that Rule 11 would lead a member into office and teach him his duties. It appeared to him a very good arrangement.

Dr. Brown remarked that it would do away with the election of President.

Mr. Curties, in seconding the resolution, observed that that was one of the points kept in view, that in case of the illness of the President, the Vice-President should fulfil his duties.

Dr. Brown said that the Vice-President might decline the office, and then there would be no machinery for the election of President.

Dr. Parsons proposed that the President should be elected a year in advance, and so give him time to think over what he would like to speak about when he assumed the office of President the following year. He begged to propose that resolution, and that on the expiration of his year of office the President should become Vice-President.

Mr. Goodinge proposed that Rule 11 be adopted, except that what had been cancelled by the previous rules should be struck out.

Dr. Parsons seconded the resolution, which was put to the meeting, and carried.

The Secretary stated that at the time when the arrangements were made for that meeting, two names were proposed for the election of President and Vice-President. Dr. Partridge had since written, and requested that his name should be taken off the list. It was too late to make any fresh nomination, and he, the Hon Secretary, thought it was right that their respected friend, Dr. George, should be elected Vice-President for this year, and President for the year following. He was one of their earliest members.

Mr. Goodinge proposed that Dr. George be Vice-President for the ensuing year, and President next year.

Mr. Teasdale seconded the resolution, which, being put to the meeting, was carried unanimously.

Dr. George said he was very much obliged to the members for the honour they had done him in electing him Vice-President. He trusted that during his year of office as Vice-President he would be able to qualify himself for the office of President in the year following.

Dr. Measures enquired if there were any changes in the Officers or Committee? No intimation of the Committee on the subject had reached him. He did not see that because Bath was the "Queen of the West," it was necessarily "the hub of the universe." He should like to see some members on the Committee from other parts of the country. He did not object to a Sub-Committee at Bath.

The President thought that there were members on the Committee from other parts besides Bath.

The Secretary read over the names of the Committee as it at present existed.

Dr. Brown enquired if the present members would continue their services? and then proposed that the present Committee be re-elected, with power to add to their number to fill up any vacancies.

Mr. Bostock having seconded the resolution, it was put to the meeting by the Chairman, and carried unanimously.

Dr. Parsons said, having satisfactorily disposed of all the business of the meeting, he should like to indulge in a little relaxation. The toast he had to propose needed no eloquence of his to recommend it. Of the Chairman, Mr. Hammond, he need not speak in praise, or of his contributions to the Society by pen, pencil, and slides. He felt the greatest pleasure in proposing the President's health. It was not saying too much to say that he was a very great honour to their Society. He had done as much as any member to raise the status of the Society and the Journal. The members of the Committee also had worked hard, much

more than some of the members had any idea. He was very sorry to hear of the resignation of Mr. Green. Their worthy Secretary was the life and soul of the Society. But for his exertions in their behalf, the Society would have dissolved into disconnected atoms. He begged to propose a vote of thanks to the President and Officers. (Applause.)

The PRESIDENT expressed his sincere thanks for the kind remarks in reference to himself. He had felt it to be an honour, and a great honour, to be President of the "Postal Microscopical Society." The office had involved by no means the amount of work which the Committee, and especially the Secretary, had to go through. He thought their thanks were very much more due to the Committee and Secretary than to himself for anything which he had done for the Society.

The SECRETARY, in responding, said that year after year it had always been his pride to hear them speak of the progress of the Society. Anything which he had attempted to do for the success of the Society he had done with the greatest pleasure. He had sometimes to grumble at members, but he always tried to do it kindly. He felt the kindness of the words that had been spoken.

The PRESIDENT said it had been his intention to have addressed a few remarks to the members on the subject of the Notes which had been contributed relating to the slides circulated in the boxes, but the time had so far advanced that he must leave the matter in the hands of the Editor of the Journal to dispose of as he thought best.

In announcing the next toast of the evening, "The President," he stated that Dr. Coombs, the new President, was unable to be present that evening.

MR. CURTIES inquired if any communication had been received from Dr. Coombs?

The SECRETARY said that on the previous morning he had received a letter from Dr. Coombs, stating that at the last moment he found himself unable to attend the meeting, but he had sent a written address. As this address would appear in the Journal, he thought it might be taken as read. He would say briefly that Dr. Coombs spoke of the Society in very complimentary terms, and dealt with the subject of "Microscopy in everyday-life," and closed his remarks with the hope that in his absence the chair would be occupied by a much better chairman. He deeply regretted his inability to attend.

MR. TEASDALE proposed the next toast, "Success to the Postal Microscopical Society." He would rather the duty had fallen to one who had done more during the last year. The Society had been worked up to a great state of efficiency, which

he attributed to the genius and untiring perseverance of Mr. Allen. The members had not in past years had everything put before them in such a highly satisfactory aspect as had been done that evening. All this was due in a great measure to Mr. Allen. He begged to propose "The continued success of the Postal Microscopical Society."

The toast was drunk with enthusiasm.

The PRESIDENT proposed the toast, "The Royal Microscopical and Kindred Societies," coupling with it the name of Mr. Goodinge, a Fellow of the Royal Microscopical Society.

MR. GOODINGE, in responding, regretted that there was no distinguished member of the Royal Microscopical Society present. They had some very pleasant meetings at the "Royal," and an excellent President and Secretary. Those who were accustomed to receive the "Journal of the Royal Microscopical Society," edited by Mr. Crisp, would see that it was very different from what it was a few years ago. Their Society was very pleased to associate itself with the "Postal Microscopical Society," believing it accomplished good work, especially in country districts. He was also a member of the "Quekett Club," and had great pleasure in responding to the toast for that Society also. Their friend, Dr. Cooke, was President of the "Quekett." It afforded him much pleasure to meet them on the present occasion. He was not a working member, as many of them knew, but he should not like to be out of the swim. He hoped soon to be receiving boxes again. He thanked them for the kind way in which the toast had been drunk.

THE REV. E. T. STUBBS proposed the next toast, "The Visitors." He felt exceedingly unworthy to propose the toast because it included the ladies, who could not answer for themselves, at least on that occasion; perhaps they might on other occasions. (Laughter.) He coupled with the toast the name of Mr. Romyn Hitchcock, the editor of "The American Monthly Microscopical Journal," whom they were all very glad to meet. It was of great importance to have visitors present, and they were always exceedingly pleased to see them.

MR. ROMYN HITCHCOCK, in responding for the Visitors, expressed his obligation to the gentleman who proposed the toast for relieving him to some extent of the embarrassing duty of responding for the ladies. Owing to the lateness of the hour, he would not detain them by many words. It afforded him great pleasure to meet the members of the Postal Microscopical Society that evening. It had a great interest to him owing to the excellent work it was capable of accomplishing, and which he had no doubt it did accomplish, through the instrumentality of the Secre-

tary and individual members. They were, no doubt, aware that they had in the United States a similar organisation, which had been in existence some 8 or 9 years and which had done great good in spreading microscopy through the country. He had taken special interest in the working of that Society. They had in the States, which were almost infinitely larger than England, a great many small towns in what was almost a wilderness. The members of that Society would be surprised, if they were situated as he was, to know how many real good workers with the microscope there were, scattered about in those small towns and villages, who had no means whatever of seeing the microscopical preparations which were made in the larger towns, except they were members of the "Postal Microscopical Cabinet Club," as it was called. To these the privileges of the Club were of great value. It was true that a great many of the slides which were circulated were of no value to anybody; at the same time, they put up with boxes of comparatively little value, for the sake of the benefit derived from the good slides which were sent round. There was one feature in which he believed the Society in Great Britain excelled their own, and that was in the completeness of the notes and drawings which were sent round with the preparations. He had frequently alluded to this matter, and in many cases a great desire was expressed that there should be an improvement. He hoped that the publication of the Journal which was associated with this Society would advance and improve the work that was done by the American Society. He begged to thank them for the kind reception he had received, and trusted that the time would soon come when their own Society would be as far advanced as the English Society. (Applause.)

Mr. Teasdale said there was a very serious omission in his previous remarks. He ought to have alluded to the Journal. They had great reason to congratulate themselves upon the present issue of the Journal, and they ought to thank Mr. Allen for his services as its editor. Mr. Hitchcock's observations had reminded them of the very great benefit it was to themselves and other societies, and he also had told them that it was appreciated in America. It was a step in the right direction, and a very successful one.

The evening's proceedings closed at a late hour. There was consequently no opportunity of inspecting the specimens which some of the members had brought for examination.

Reviews.

Studies in Microscopical Science. Edited by Arthur C. Cole, F.R.M.S. Vol. I., with Fifty Three Lithographic Plates. (*London: Baillière. Tindall, and Cox.*) 1883.

The first volume of these most valuable studies, neatly bound in cloth, is now before us. It consists of 330 pages, including a very copious index. Throughout the entire work, each subject appears to be treated in a very thorough manner; *e.g.*, we find that each subject is, first, considered Etymologically; next Descriptively; the various methods of Preparation are next given; then we have the complete Bibliography of the subject.

The entire work is divided into two sections, which were delivered alternately to weekly subscribers. Section A. is devoted to Animal Histology. Section B. divides its favours between Botany and Petrology. In this section we need not say that Botany takes the chief share of the work. The individual subjects have been so frequently brought before the microscopical world, both in this and other journals, that we feel it unnecessary to repeat them here; suffice it to say, the plates are, without exception, executed in a very superior style of chromo-lithography, and many of them are of double size. Of the slides which accompany these studies, we feel that it would be a waste of words to say more of them than that they are prepared and mounted by Mr. A. C. Cole, of St. Domingo House.

Popular Microscopical Studies. Edited by Arthur C. Cole, F.R.M.S.

Studies in Microscopical Science. Vol. II. Edited by Arthur C. Cole, F.R.M.S.

The Methods of Microscopical Research. An Introductory Essay to Vol. II. of the "Studies in Microscopical Science." Edited by Arthur C. Cole, F.R.M.S.

Having completed the first volume of the "Studies" with so much credit, and, we trust, with an equal amount of satisfaction and profit to himself, Mr. Cole has launched out into three very excellent works, in each of which we trust he may meet with the encouragement he so richly deserves.

Of the Methods of Microscopical Research, the first four parts are to hand, and appear fully fitted to form an Introduction

to the Study of Microscopy in general, or of Mr. Cole's "Studies" in particular. The subjects at present laid before us are entitled, On Instruments, Reagents, Methods of Preparation, Microscopical Art, The Microscope, The Human Eye and its relation to Microscopical Observation, The Preparation of Animal Tissues. This latter subject, as we naturally expected, from a man of such practical experience, is treated in a very masterly manner.

Two parts only of the "Popular Studies" are to hand. No. 1 is devoted to Hebridian Gneiss, and gives, first, a description of the Rock, and next, How to Prepare a Rock-Section for the Microscope, and is illustrated with a fine coloured lithograph. No. 2 is descriptive of the Human Scalp, the hair being minutely described. This number is illustrated with a coloured plate of Hor. Sec. of the human scalp injected.

Of the "Studies in Microscopical Science," seven parts have reached us, and are, as a whole, we think, quite equal to those of Vol. I. The series, as was that of last year, is divided into two classes, viz., Animal and Botanical, the subject of study in each case up to the present being the Morphology of the Cell; the chromo-lithographs issued being Polycystina, Globigerina ooze, Lon. Sec. Scale-Leaf of Fritillaria imperialis, Trans. Sec. Stem of Pinus Sylvestris, Blood of Frog, and Arachnoidiscus Ehrenbergii.

THE AMERICAN PSYCHOLOGICAL JOURNAL. Issued by the National Association for the Protection of the Insane and Prevention of Insanity. Vol. I., No. 3, October, 1883. (*P. Blakiston, Son, and Co., Philadelphia.*)

This is a well-got-up quarterly, and appears to handle the subject in a very masterly manner.

THE SCIENCE MONTHLY. (*David Bogue and E. W. Allen.*)

Parts 1 and 2 of this new illustrated monthly are to hand. The contents are, as we are led to judge from the title, of a varied character, well selected, and of a particularly interesting nature, and the illustrations are good. In *The Museum*, No. 1, we find a paper on Microscopy by Mr. Geo. E. Davis, and in No. 2 on the Verification of Microscopical Observations by Mr. A. McCalla, Pres. Amer. Soc. Micro. Under the "Leaders of Science," we have portraits of Sir G. B. Airy and Sir John Lubbock.

The Bathes of Bathe's Ayde, in the Reign of Charles II. By Chas. E. Davis, F.S.A., etc. (*Bath: Printed by William Lewis and Son, and to be sold by them at the Towne Gate, at the sign of the Herald.*) MDCCCLXXXIII.

This book comes very opportunely after our two articles in the last Part of this Journal on "Organisms Found in the Newly-Discovered (Ancient) Baths of Bath," and "A Description of the Ancient Roman Baths."

We have before us now a book got up in the style of the 17th century, and illustrated by a photograph from a drawing of the King's and Queen's Bath of that date. After giving an account of the Mineral Baths as they were used at that period, a description of "ye antient citie" follows, "whereunto" is annexed a visit to Bath in the year 1675 by a "Person of Quality."

Of a similar book written on any other city, we should be inclined to say that it was of "considerable local interest," but of the book before us we may assert that it is of *general* interest. We have just heard that Her Most Gracious Majesty the Queen has been pleased to accept a copy.

VIGNETTES FROM INVISIBLE LIFE. By John Badcock, F.R.M.S. (*London: Cassell and Co.*)—The author says:—"This book assumes as a fact that very few, even otherwise well educated people know anything of the life here treated of, and consequently pretends to convey that knowledge to them, or at any rate to introduce the subject to their notice, and so peradventure awaken such an interest in their minds as shall induce further investigation." We have read the book with a great deal of interest. It treats of Plant-Animals (*Vorticella*, etc.); Brick-Makers (*Melicerta*, etc.); Crystalline Vases (*Stephanosceros*, etc.); Revolving-Plants (*Volvox*); Hydra; Water-Bears; a Subaqueous City (Sponges); and many other equally interesting subjects. The descriptions are written in a thoroughly popular and very readable style. The Vignettes, of which there are 27, are well executed.

We have recently received the first three parts of Mr. Wheldon's Catalogue of Zoological Works. (*London: 58, Great Queen Street.*)—Part 1 is devoted to works on Entomology, Parts 2 and 3 to works relating to Mollusca, Conchology, Crustacea, Corals, Zoophytes, Reptiles, Transactions of Societies, and Microscopy, besides the higher orders of Zoology.

SCIENCE RECORD, Vol. II., No. 1. (*S. E. Cassino and Co., Boston, U.S.A.*)

This magazine came to hand at the moment of going to press. We have only space to say that the majority of the papers relate to Microscopy; whilst those devoted to Physical and Natural Science are short and somewhat unconnected. The number contains 24 pages, to which are added 12 pages of advertisements.

THE NATURALIST'S WORLD and Scientific Record, Vol. I., No. 1. (*London: W. Swann, Sonnenschein, and Co.*)—A well got up little Magazine. Its subjects are simple, varied. and pleasantly written.

Current Notes and Memoranda.

OUR readers will be pleased to learn that Handsomely-bound copies of the two first volumes of the "Journal of the Postal Microscopical Society" have been sent to H.R.H. Prince Leopold, Duke of Albany, for which His Royal Highness has expressed his thanks, and states that he evinces great interest in the work of the "Postal Microscopical Society."

A rich treat for the members of the Postal Microscopical Society has just been afforded through the kindness of Miss E. E. Jarrett, in the shape of a unique and almost exhaustive series of slides, showing the Fructification of the greater portion of our known Ferns.

The whole are systematically arranged in a handsome mahogany Cabinet, accompanied by a note-book, made to fit, of which some 90 or 100 pages of MS. descriptive notes are already added. As the cost of the carriage of this box may, by some members, be considered excessive, it will be sent only to those who desire to see it. The charge for postage from one member to another will be 9d., as it weighs under 5 lbs. Each member may keep it 7 days only, and if a special circuit can be formed for it, they will simply be required to pay postage to next name on the list. Otherwise they must, of course, pay postage both ways. Space is left in MS. book for further notes and observations.

F

We have much pleasure in informing our readers that the Depôt which has been opened in Jersey for the supply of Natural History specimens is proving a great success.

We are given to understand that Messrs. Sinel and Co. have peculiarly favourable opportunities for procuring all kinds of Microscopical Marine Life, which they carefully name and preserve. The slides, which are unique in their method of preparation, are specially adapted for spot-lens illumination. These we can recommend with confidence to our readers.

Jersey, with its almost tropical climate, affords a rich hunting-ground for the naturalist, and we are glad to find that Messrs. Sinel and Co. have secured the opportunity, and that they are meeting with a most cordial response to their undertaking.

Students of marine life will do well, first, to write for Sinel and Co.'s Circular, and then make a judicious selection.

We have ourselves received repeated orders from America for Sinel and Co.'s specialities, and have been told that their 5s. jars of living marine organisms have given great satisfaction.

Mr. Wm. West, of Bradford, has favoured us with a large selection of his objects, prepared for microscopical mounting, consisting of Diatoms, Spicules, Animal Hairs, Palates, Anatomical Sections Injected and Stained, Vegetable Sections Double Stained, and Miscellaneous, both Botanical and Non-Botanical.

These objects are prepared by S. Louis, of Paris. At present we have had time to mount but a few of the above. We think they are all well prepared. The quantity is abundant, and in many cases quite sufficient for a number of slides.

Skeletons with Care.—The above was the startling label attached to a somewhat bulky parcel received by "Parcels Post" a short time ago. That the editor's sanctum is often the reception-room for strange visitors is, of course, tolerably well known; but that skeletons should thus introduce themselves is a little out of the regular run of common events. Who could our skeleton visitor be and what could be his errand our well-used scissors soon solved.

Readers of Parts 7 and 8 of our Journal, published together in October, will remember that we stated that Mr. E. Wade-Wilton, of Leeds, was now directing his attention to the supply of Animal and Vegetable specimens suitable for Biological Class Demonstration. The skeleton referred to proved to be that of a

Frog (*Rana temporaria*), excellently cleaned and mounted on a stout, dead-black mill-board. The various limbs, so far as is practicable, are detached and arranged in natural order on the board, to which they are affixed by an elastic cord, so that each may be removed for individual inspection. Thus we have—The upper part of the head with the vertebra, the lower jaw, the two arms and hands, the sternum, the hyoid bone or cartilage, the pelvic arch, and the two hind legs and posterior hands.

In a separate box, Mr. Wilton has also sent us the head of a Frog, mounted on a small, square, black card. We are much pleased to receive these specimens, and think that Mr. Wilton's energies are being applied in the right direction, and trust that he may be well remunerated for his labours. We understand that Mr. Wade-Wilton has gone so largely into his new enterprise that he is now able to take orders for dozens of his various subjects on very liberal terms, and that single specimens of the entire skeleton may be purchased of him for 4s. 6d., or one where the whole skeleton is permanently attached to the card for about 3s. 6d. We suppose the head alone mounted on a card in a neat box will sell for about 2s.

THE AMERICAN NATURALIST has just completed its 17th Vol. The promises made by its editors in the January part, have been very honestly carried out, and we have before us a volume of some 1330 pages, carefully printed, and well illustrated. The December part, which reached us a few days ago, contains several articles of much interest to the Microscopist, amongst which we may mention "Development of the Dandelion," "Notes on the *Chætonotus larus*," an animal about 1-225th of an inch in length, found in the fine *débris* over the bottom of ponds, streams, and springs: "Experiments with the Antennæ of Insects." Owing to its size, the volume is divided into two parts, each supplied with a valuable index.

Mounting Minute Insects and Acari in Balsam.—Mr. A. D. Michael describes his process in the "Quekett Journal" as follows—He first kills the creature in hot water or spirit; hard insects and *Acari* are best killed in hot water, which causes them to expand their legs, but spirit is better than water for minute flies. Next wash the object thoroughly in spirit, and clean with badger's-hair brush, leave it in spirit for a time, tilt the slip to drain off the spirit, but do not dry the object, which should *never* be allowed to dry from first to the final mounting. Having drained off the spirit, drop on the object a little oil of cloves, slightly warm the

slide, and put on a thin cover-glass, which must be supported so as not to touch the object; leave it until thoroughly soaked. If necessary, remove to a clean slip for finally mounting. Drain off the oil of cloves and put on a quantity of Canada balsam in benzole; arrange the creature on the slide. Let the balsam harden a little, and then the object will not float off, as often happens when a quantity of balsam is used at once. Lower the cover on to the object. It is better not to put enough balsam to fill the space under the cover, as the balsam supports the cover if it does not reach the edge, but if it reaches the edge it is apt to draw down the cover and crush delicate objects. A few pieces of thin glass to support the cover are a great protection to the object, or better still, a few tiny glass beads.

Finish off with a ring of Bell's cement, but this must only be done if the cover is supported as recommended.

We regret that our article in the present issue on the FORAMINIFERA OF GALWAY proved to be too long for insertion in one part. We hope to complete it in April, and at the end of the article shall give the explanation to the four plates, with the exact magnification of each form.

Whilst correcting the last proof-sheet of our Journal, we received a communication from S. C. Hall, Esq., President of the CARLISLE MICROSCOPICAL SOCIETY, from which we learn that Dr. W. B. Carpenter has been made Hon. Vice-President of that Society.

In a letter in which Dr. Carpenter accepts the office of Vice-President he suggests that Microscopists should study more thoroughly the *life* history of Diatoms, Monads, and Disease-germs.

We regret that space forbids our publishing the Doctor's letter *in extenso*, but hope to refer to it on another occasion.

THE JOURNAL OF MICROSCOPY
AND
NATURAL SCIENCE:

THE JOURNAL OF
THE POSTAL MICROSCOPICAL SOCIETY.

APRIL, 1884.

On Psychoptera Paludosa.

By A. Hammond, F.L.S.

Plate 9.

EARLY in the spring of last year I found some sluggish-looking larvæ in the mud of a pond near Finsbury Park, which I at first thought were the Rat-tailed maggots, the larvæ of the Drone Fly, *Eristalis tenax;* but on reaching home, I soon found this was not the case, and on reference to Lyonet,* discovered the object of my search in one of his plates as a Tipulid Fly, under the title of *Psychoptera paludosa.* On page 192 he describes the insect in all its stages. I have, myself, only seen the larva and pupa, which present several points of interest, and which I purpose here to recount, contenting myself with Lyonet's description of the imago. The larvæ are of a dirty white colour, the transparent integument allowing much of their organisation to

* Recherches sur l'anatomie et metamorphoses de differentes espèces d'insectes.

be seen through it, especially the fat-bodies, which are conspicuous by their brilliant white colour and great size.

They lie on the mud, covered by a mere film of water, the respiratory tail floating on the surface, and appear almost motionless, their only means of movement, indeed, being the successive contraction of the segments of the body, aided by the slightly thickened ring, with which each is furnished. That they pass much of their life buried in the mud, however, appears from the fact that I have frequently observed its exposed surface in their haunts to be pitted with holes, and that whenever this is the case a plentiful supply of these larvæ is sure to be obtained by digging up a handful with a trowel. It is remarkable that the first occasion on which I found the pupa was as early as March, whereas Lyonet states that with him they underwent their transformation in June. I have myself found them from March until as late even as July. Probably Lyonet's observations were made upon a few specimens kept for the purpose, and which were all exposed to one uniform condition.

The head of the larva, see Plate IX., Fig. 5, is hard and horny, in striking contrast to the softness of the rest of the body. Lyonet describes it as furnished with a pair of appendages similar (as I gather from his figures) to those which I believe to be antennæ in the larva of *Tanypus maculatus*.* I have not been able to verify this, the two minute projections seen in my drawing of the head being, I think, the maxillary palpi. A pair of minute black spots on the upper surface, as in *Tanypus*, represents the eyes. The most interesting portion of the organisation of this insect is the respiratory system. Like all other dipterous larvæ it is furnished with a pair of conspicuous tracheal trunks, extending the whole length of the body, and prolonged in this instance into the filamentous tail, which is simply the terminal segment very much attenuated and prolonged (see Fig. 2). At the base of this segment two styliform appendages occur.

The trachæ in this part of their course are simple tubes, having the usual spiral fibre in their walls, and much convoluted near the base of the tail. I do not think these tubes have any

* See "Journal of the Postal Microscopical Society," June, 1882.

spiracle or orifice at their extremity, and it is probable that respiration is effected by the absorption of air through the whole length of the tail as it floats on the surface, almost in contact with the atmosphere. The tail is capable, according to Lyonet, of being retracted to a certain extent within the body of the larva, special muscles for this purpose being provided.

The continuation of these tracheæ within the body of the larva presents some special characteristics, which appear to be connected with its habit of passing a considerable portion of its life buried in the mud. With the exception of the first three and last three segments, the tracheæ during the middle part of their course are very large and swollen in the centre of each segment, the connections between the enlarged portions being comparatively small. Each of the two tubes thus assumes the appearance of a succession of bladder-like cavities, joined to each other by narrow necks, from which arise the smaller branches, which are distributed to the various organs (see Fig. 6). Furthermore, a section across one of these cavities does not show a circular form, as is usually the case with the tracheæ of insects, but one more or less resembling that shown in Fig. 7, where it will be seen, that while the lower surface of the somewhat flattened trachea is entire, its upper surface is marked with two deep longitudinal furrows, seen in section at *a.a.* The spiral fibre, elsewhere very marked, strong, and of a deep colour, thins out as it passes over these furrows (see Fig. 8), some of the coils disappearing altogether, and becomes again specially thick and strong as it passes round the ends of its course, where it forms the sides of the flattened tube.

The elasticity of these strong portions of the coil, when the tracheæ are in a flaccid condition, presses the central portion of the upper surface against the lower, the walls yielding along the course of the furrows, where the resisting fibre is almost wanting, and the capacity of the tube is thus very much diminished, as shown in Fig. 7. When, however, the tracheæ are filled with air, the thickened ends of the coil yield to the expansive pressure, the section of the tube becomes almost circular, and its capacity is enormously increased. This arrangement is evidently adapted to admit of great variations in the amount of air contained in the tracheæ, a large quantity being probably required when the insect

lies deep in the mud, while a much smaller amount suffices when lying on the surface in very shallow water.

I have not been able to follow out in its entirety the alimentary system, but can furnish a few facts concerning it. The proventriculus* is bell-shaped (see Fig. 9), the œsophagus being continued down into its cavity to form the clapper, and reflected back again over itself to form the roof. This is exactly similar to what occurs in the larva of the Crane Fly.† The mouth of the bell is surrounded by eight cæca, from which arise occasional bud-like projections (see Fig. 10).

The proventriculus is succeeded by the ventriculus, or stomach, which is straight and of considerable length, tapering down gradually into the intestine. In this may be distinguished two portions, corresponding in relative size to the small and large intestines of vertebrate animals. A similar distinction occurs in many insects, notably in the Blow Fly,‡ and also in the larva of the Crane Fly,§ where the analogy obtains even more strongly, owing to the presence of a large anteriorly directed process of the gut, corresponding apparently to the cæcum of vertebrates. In *Psychoptera*, however, no cæcum is developed, but the intestine is coiled once upon itself at this portion of its course, and thence proceeds straight to the anus. Viewed in relation to their embryonic origin, this portion of the intestine, including the proventriculus and stomach, may be called the mid-gut; the large and small intestines constituting the hind-gut. I have not been able to trace the course of the biliary tubes, or malphigian vessels, as they are variously called, but have observed through the transparent skin a mass of coiled vessels of a deep reddish-brown colour, which are probably the organs in question. Lyonet appears also to have noticed this.

The fat-bodies of these larvæ are very conspicuous, both in the living insects and in dissected, spirit-preserved specimens. They

* Compare larva of *Tanypus maculatus*.—"Postal Microscopical Journal," June, 1882.
Also *Maggot of Blow-Fly*, same Journal, March, 1883.

† See my article on the Larva of the Crane Fly in "Science Gossip," Jan., 1875.

‡ See Lowne's "Anatomy of the Blow Fly," p. 57.

§ See "Science Gossip," Jan., 1875.

consist of ribands of cellular tissue containing fat-globules, which, from their great number and minute size, refract the light strongly. This tissue is that in which the material which is partly used up in the pupa stage is deposited, and in consequence not much of it is found in the perfect insect.

The transformations of this insect resemble strongly those of the Crane-Fly. Before the conclusion of its larval life, the growing limbs of the pupa may be seen beneath the larval integument of the thoracic segments, as roughly indicated in Fig. 11. The differences between the mode of development of the Crane Fly and the Blow Fly have been already described by me in a paper read before the Quekett Microscopical Society,* and the remarks therein applied to the Crane Fly will be equally applicable to this insect. Unlike the coarctate pupa of the Blow Fly, that of this insect sheds its larval skin and has its limbs exposed, as seen in Figs. 3 and 12, and this seems to be connected with a more gradual and less radical process of internal change. The larval tissues do not undergo the total degeneration and reconstruction that they appear to do in the Blow Fly, and the pupa retains a small amount of voluntary motion.

In the pupa, as well as in the larva, the most curious part of the structure of this insect is its respiratory organs. Lyonet states that the respiratory trunks of the body and their continuations into the tail are left behind in the larval skin; and he goes on to express great surprise that the respiratory tail of the larva changes its place in the pupa, and instead of being found, as heretofore, a continuation of the abdomen, takes a new departure from the thorax of the insect, immediately behind the head. This arises from a misapprehension due probably to imperfect optical appliances. His explanation of this subject is almost amusing, did we not recollect the disadvantages under which he laboured, as compared with the facilities of modern microscopic research. I will give it in his own words. He says, "Quoique cette queue dans l'état de ver soit plus grosse et bien de la moitié moins longue que dans l'état de nymphe, on ne saurait pourtant douter que l'une et l'autre ne soient le même conduit de la respiration et

* See "Journal of the Quekett Microscopical Club," Jan., 1876.

que la difference de leur longueur et de leur emplacement ne proviennent que de ce que, dans l'état de ver, ce canal traversait sous la peau de l'insecte, la longueur de son corps, pour aller s'insérrer dans ce qui devoit devenir le haut du corselet de la nymphe ; et qu'après avoir quitté la peau de ver pour revêtir la forme de nymphe, cette partie du canal de la respiration que la peau du ver couvrait s'offrant a découvert, fait paraître, par là ce canal d'autant plus longue et attaché au corselet. La réunion des deux files de vaisseaux bruns qui vont sous la peau du ver de la queue jusque pres de la tête et s'abouchent à cet endroit l'un avec l'autre, et qui dans cet état ne paroissent être que ce même canal de la respiration continué semble confirmer cette idée, quoique alors on ne conçoive pas aisément par quelle mechanisme deux vaisseaux, auparavant séparés se sont réunis pour n'en former ensuite plus qu'un, ou se sont joints sous une même enveloppe."

The whole of this pother arose from the fact that Lyonet did not perceive that the respiratory filament of the pupa was not a single organ, but that it was one of a pair, of which one only is developed, the other remaining rudimentary, see Fig. 12. They are the superior pro-thoracic processes, and correspond on the prothorax to the wings and halteres on the succeeding two segments. Their development, however, ceases with the pupa stage, being totally suppressed in the perfect insect.

They are both rudimentary in the pupa of the Blow Fly, and but poorly represented in that of the Crane Fly. In this insect one only is fully displayed, but in the pupa of the Gnat and *Corethra plumicornis* they are both seen to the greatest advantage. In all cases where they are developed they subserve the process of respiration. Lyonet says that the terminal portion of the filament of *Psychoptera* is flattened and twisted into a helix, and that the insect is capable of lengthening it by unrolling the coil to suit the depth at which it lies in the water, and of shortening it again when the necessity has passed away. I have not observed this, nor do I quite see how it is to be accomplished; but the statement may, nevertheless, be correct. The corkscrew twist I indeed recognise, but not the knotted thread extending along the wall of the filament, by which Lyonet further states its extension or retraction to be effected.

The filament (see Fig. 13) is composed of an exterior integumental wall enclosing a trachea, the latter being a continuation of one of the main tracheal trunks. The external wall is marked by a thickened spiral ridge projecting internally, and having a corresponding external spiral depression. This wall thins out towards the extremity, where it becomes a mere film of membrane surrounding the trachea, see Fig. 15, *m*. At intervals between the coils there are found elevations (see Figs. 13, 14, and 15), consisting of a horny ring, over which the integument extends in a thin inflated bladder. The wall, too, of the enclosed trachea appears here to lose its spiral form, and to pass as a delicate internal lining into the cavity of the bladder, to which it is closely applied. The total thickness of both linings in these organs is so small as probably to readily admit the passage of air through them into the trachea, either by direct contact, or through the medium of the surface water in which the filament floats. They thus form closed stigmata, admitting the air through their tissues, but excluding the water; a modification of the closed tracheal system peculiar to all exclusively aquatic insects, another form of which exists in the tracheal gills of the *Ephemeridæ*. It may be asked why these organs are found in the respiratory filament of the pupa, while they are absent from that of the larva. The question, I think, admits of the reply, that the integument of the former is much denser, at least in its basal portion, than that of the latter, hence the necessity for specialised portions of it devoted to the fulfilment of its function; hence, also, we find that as we approach its extremity, where the external wall thins out, these organs almost disappear, the respiratory process being carried on over the whole surface of this portion of the filament. The filament is terminated by a pretty crown of incurved horny teeth, like the peristome of a moss, see Fig. 16. I do not think this is an open stigma any more than the bladder-like organs just described, but that it is also closed in by a delicate film of membrane.

The spirals of the external wall appear to be broken at opposite points of their course, a line of these interruptions thus occurring on either side of the filament. The abortive corresponding filament to which allusion has been made is so small as easily to escape detection; it differs from its fellow, not only in point of

size, but also in the absence of the toothed crown, its place being taken by a simple infolding of the external wall to form the extremity of the trachea, a constriction occurring at this point to prevent the access of water, see Fig. 17. It has been asserted by Mr. Lowne* that the spiracles of insects, together with the tracheæ, are invaginated lateral appendages, similar to the wings and legs, developed inwardly instead of outwardly. If we regard the probable course of development of the functions of the body in the animal kingdom we may conclude that, as the function of respiration probably preceded even that of locomotion, as being the more necessary to the existence of a living being, the converse of this is rather the case, and that the appendages, at least the superior ones—namely, the wings, halteres, and the pro-thoracic pupal appendages in question—are externally developed respiratory organs, in many cases diverted from their original function ;† but be this as it may, there appears to be a striking amount of similarity and of continuity in the coils of the external wall of the filament of *Psychoptera* to the finer spirals of the enclosed trachea, which suggests that the whole organ is a trachea pushed outwards.

I must conclude with Lyonet's account of the perfect insect, see Fig. 4. He says: "Its predominant colour is black; the legs and extremity of the abdomen are the colour of dead leaves; the antennæ are black, and composed of sixteen knots, furnished with very minute hairs. Every joint of the legs is marked with a black spot. Its most notable peculiarities are, however, first, the form of its body, the base of the abdomen being very slender, and this is followed by three swollen rings, the last of which ends in a point; and secondly, the painting of the wings, the nervures of which are not only very black, but are adorned with numerous spots of the same colour, giving it a very ornate appearance."

* "Anatomy of the Blow Fly," p. 3, note.

† In this way we should view the incipient wings of the Ephemera larva as modified tracheal gills, and not both these organs as differentiations from originally indifferent appendages.

EXPLANATION OF PLATE IX.

Fig. 1.—Larva of *Psychoptera paludosa*, slightly magnified (Lyonet). The inflated tracheæ extend from *A.* to *B.*

,, 2.—Respiratory tail of larva, more highly magnified. *B. C.*, penultimate segments; *D. D.*, styliform appendages; *E.*, convoluted tracheæ; *F. F.*, muscles (Lyonet).

,, 3.—Pupa, slightly magnified, showing the respiratory filament arising from the thorax, and the folded wings and legs (Lyonet).

,, 4.—The perfect insect, natural size (Lyonet).

,, 5.—Head of the larva, from beneath. *mx.*, maxillæ; *mxp.*, maxillary palpi; *lr.*, labrum.

,, 6.—Portion of one of the main tracheæ, showing two segmental swellings.

,, 7.—Section of ditto, across × ×. *a. a.*, longitudinal furrows.

,, 8.—A few of the spiral fibres of tracheæ, showing the thinning-out of the fibres at *a. a.*, and the thickened sides of the coil.

,, 9.—Portion of the alimentary canal, extending from the proventriculus to the anus. *p.*, the proventriculus; *c.*, its cæca; *s.*, the stomach; *si.*, the small intestine; *li.*, large intestine, or colon.

,, 9*a*.—Section of proventriculus, showing intus-susception of œsophagus.

,, 10.—Cæca of proventriculus.

,, 11.—Limbs of pupa, seen through thoracic integument of larva. *l. l. l.*, legs; *w. w.*, wings.

,, 12.—Head and thorax of pupa, seen from the side. *f.*, base of respiratory filament; *f′*, its aborted fellow; *a.*, antennæ; *lb.*, labium; *lp.*, labial palp; *l. l.*, legs; *w.*, wing; *h.*, haltere.

,, 13.—Central portion of respiratory filament, with bladder-like elevations.

,, 13*a*.—Portion near the extremity.

,, 14.—One of the elevations from the central portion of the filament, side view. *r.*, horny ring; *c. c.*, external coils; *t.*, trachea.

,, 15.—Ditto from terminal portion. *m.*, membranous continuation of external wall; *f.*, fibres of trachea.

,, 16.—Terminal toothed crown of filament. *m.*, membranous external wall.

, 17.—Aborted filament, showing at *x* the constricted extremity of the trachea.

The Foraminifera of Galway.

By F. P. Balkwill and F. W. Millett, F.R.M.S.

Plates 1, 2, 3, 4.

SECOND PART.

ENTOSOLENIAN LAGENÆ.

Obsolete in classification, but convenient for arrangement; round in section.

Lagena globosa.—Smooth, pyriform, or globular, with projecting nose, opening by radiating pores; fissurine, with fine pores arranged within a slit, or having a circular aperture; frequent.

In this and some other *Lagenæ*, a vestibule is formed by a perforated diaphragm, roofing the funnel-mouthed entosolenian tube.

Lagena aspera (Pl. II., Fig. 1).—Oval, with short, cylindrical tube; shell tuberculated; tubercles sometimes formed of lines and dots as if from imperfectly-developed ribs; also, one specimen, ectosolenian, pyriform, with long neck.

Lagena caudata.—Oblong, ovate, truncate, emarginate, or having a produced tube more or less bent. This "cauda" is, in fact, the entosolenian tube produced, and reminds one of the articulated peduncle of a vegetable marrow, it is so dissimilar to anything else common in the genus as to be characteristic, and when once the species is recognised, it can scarcely be mistaken even if no "cauda" be present. The striæ are so fine as to give a milky appearance under the 1-in. and usually require the ½-in. object-glass to resolve them.

Lagena Williamsoni.—Pyriform; ribs, about sixteen, starting from initial small circle at posterior broad end. Near the apex they unite and reticulate in small hexagons to the nipple-shaped aperture. In transverse section this resembles *L. sulcata;* circular in outline, the sharp ribs being joined by semi-circular grooves; common.

Two Lagenas in this material require notice: one elongate or narrowly pyriform, with few fine ribs, like *L. striata punctata*, but without the punctures of that well-marked species; the other nearly globular, like *L. sulcata*, but with or without a very short ectosolenian tube, the ribs being continued up to the very minute circular aperture. Though not "common," too many specimens

of this latter sort occurred to allow the idea that they were *L. sulcata*, with the tube broken off, besides being different in shape, and they are not found in many localities where *L. sulcata* is plentiful. The former may be considered a variety of *L. striato punctata*, from its being so much more like that than any other species.

LAGENA SQUAMOSA.—Pyriform or ovate, with various reticulations, neither hexagonal nor with uniform height of surface. We have found Montagu's form, in which the ribs are in half circles, touching each other, to form a ring round the shell, each side of the curve springing from the centre of that below it, so as to form a diagonal pattern. More frequently the semi-circles are produced into croquet-hoops and follow each other in line, decreasing in size from the broadest part of the shell to about one-third or a quarter from the apex, the convexity being always towards the aperture. Looking vertically at it as it stands, mouth up, sixteen radii appear, connected by decreasing parallel curves, the concave side outwards, so that the circular outline, made up of sixteen concavities, resembles that of *L. Williamsoni* and *L. sulcata*. In another form the ribs resemble the veining of endogenous leaves, longitudinal costæ connected by smaller transverse riblets; in others, the reticulations are diagonal.

LAGENA HEXAGONA.—Pyriform, reticulations hexagonal, ribs thin, pits deep, nearly hemispherical, axis of hexagons in the meridional line, usually a nipple-like, very short neck; an ovate form, with or without this neck, and shallower areolæ, has the meridional line of hexagons connected by their sides instead of their angles.

LAGENA HEXAGONA (variety, SQUAMOSA, WILL.) has broader margins—which are not parallel in thickness—of uniform height, dark when seen against a black background, in striking contrast to the frosted areolæ, which are irregularly three to six sided, some being two or three times as long as broad. These pits are not so sunk as in *L. hexagona*, and look as if dug out by a round-ended trowel; the nipple-like neck usually wanting.

OVAL, ELLIPTICAL, TRIGONOUS, OR TRIQUETROUS IN SECTION —*i.e.*, having two or three more or less flattened sides, or winged.

We have now to discuss the trigonal forms of the compressed *Lagenæ*, which occur in this gathering in an abundance and a variety for which there is no parallel. Hitherto, it has been the custom to give a distinctive name to each of these abnormal forms without regard to the name of the species from which it is derived, but then the number of varieties known was very small. Now, we have trigonal forms of nearly all the compressed *Lagenæ*, and although we cannot take it upon ourselves to alter a well-established

custom, we give under protest names to the new trigonal forms in the belief that by this *reductio ad absurdum* the older names may be swept away, and the forms in future spoken of as merely "trigonal growths" of each particular species.

As if to emphasise our difficulty, specimens have turned up of *L. Orbignyana* and *L. clathrata*, possessing four keels (Pl. IV., Figs. 2 and 3). These require distinctive appellations, so we must name them *L. quadrigono-Orbignyana* and *L. quadrigono-clathrata* respectively.

Probably, the trigonous form which appears to be common to all the flat *Lagenæ* is the analogue of the double form of the round ones. In this case, it seems likely that two individuals, or embryos, have coalesced before forming the shell, and by their adhesion together one of their four sides is suppressed, the external surface being reduced by contact so as to develop but three more or less perfect sides. In all cases, as in the double forms, the additional portion is developed upon the same type as the rest, thus supporting the validity of their specific unity.

We have bilocular forms of *Lagena*, of the following species, viz. :—*sulcata*, *clavata*, *Williamsoni*, *costata*, *squamosa*, *caudata*, and *Lyellii*. Of these, *L. sulcata* and *L. clavata* are attached laterally, with a common neck; *L. caudata*, longitudinally, with divaricating apertures; *L. Williamsoni*, *L. costata*, and *L. squamosa*, anterio posteriorly; and finally, *L. Lyellii* is similar to the last, except that the posterior chamber embraces a portion of the anterior one in a Nodosarine manner.

In the trigonous forms, the third rib sometimes stops short of the base of the shell, and consequently does not join the others at that part. It seems never to fail in reaching the apex.

Lagena lucida (Pl. II., Fig. 7).—Oval in section, with linear fissurine mouth, in which are punctures through the linear diaphragm. This has a translucent surface, with a broad, semi-opaque horseshoe band on each side, caused by minute tubules in the shell-substance, usually broadly ovate, cuneate; an elliptical form, with an acute base, is named *L. acuta*, by Brady.

The trigonal form of *L. lucida* has been known as *oblonga*. *Lagena trigono-oblonga* (*lucida*), Pl. III., Fig. 4.

Lagena lævigata (Pl. II., Fig. 6).—This is half as large again as *L. lucida* usually is, has not the peculiar marking, is rounder in section, longer and more uniform in shape, ovate lanceolate obtuse, the fissurine aperture is as in *L. lucida*. This form is commoner in 50 fathoms, and seems to represent *L. lucida* at that depth, as *L. costata* similarly supplants *L. Williamsoni*, which it also exceeds about as much in size.

LAGENA TRIGONO-LÆVIGATA (Pl. III., Fig. 6).—The aperture is formed by tri-radiating slits.

LAGENA FABA (Pl. II., Fig. 10).—Is oval in equatorial section. Seen on edge the outline would be cordate lanceolate, with everted lips. These lips enclose an elliptical, funnel-shaped diaphragm; surface rough, like that of an orange. Outline broadly circular truncate, the elliptical mouth forming a straight edge when viewed laterally; two narrow, curved, opaque white bands, nearly joining at the bottom, extend three-quarters up each side within the margin of each face of shell; internal tube central and free, as in *L. lucida*. Very common!

Seguenza, in his "Foraminiferi Monotalamici" (Pl. I., Fig. 60), figures a form similar in outline, but describes it (page 60) as having an acute keel; he names it *Fissurina aperta*.

LAGENA QUADRATA (Pl. II., Fig. 8).—Oblong, in outline more or less quadrangular; it varies in proportions of length, breadth, and thickness.

LAGENA QUADRATA, VARIETY, SEMI-ALATA (Pl. II., Fig. 9).—Has a simple wing, connecting the neck with the shell.

This pretty variety of *L. quadrata*, figured by Williamson, seems worthy of a distinctive name.

LAGENA MARGINATA (Pl. III., Fig. 2).—Transparent, smooth, with but one keel. In this, *L. Orbignyana* and allied forms, the tube adheres to one of the inner surfaces of the shell. The mouth of the tube opens mostly on the opposite face in this species; contour nearly circular.

LAGENA TRIGONO-ELLIPTICA (Pl. III., Fig. 8).—This specimen has one keel at each angle; the tube is central and very short. In shape this is elliptical, and in cross section triquetrous.

A similar form is described by Seguenza, under the name of *Trigonulina globosa*, but this specific name is occupied, as is also the more appropriate one of *trigono marginata*.

LAGENA PEDUNCULATA (Pl. III., Fig. 3).—An interesting variety of *marginata*, figured by Seguenza, *loc. cit.*, Pl. 2, Fig. 4, page 60.

LAGENA ORBIGNYANA (Pl. III., Fig. 1).—Has three keels, the central one broadest; surface smooth.

LAGENA TRIGONO-ORBIGNYANA (Pl. III., Fig. 10).

LAGENA PULCHELLA (Pl. II., Fig. 13).—A variety of *L. Orbignyana*, the surface marked with branching costæ.

LAGENA TRIGONO-PULCHELLA (Pl. III., Fig. 11).—Also found by Balkwill and Wright in Dublin waters, and recorded as *L. pulchella*.

LAGENA CLATHRATA (Pl. II., Fig. 14).—A variety of *L. Orbignyana;* the surface is marked by parallel striæ.*

We have also found a few specimens which are intermediate between *L. clathrata* and *L. castrensis.*

LAGENA LAGENOIDES (Pl. II., Fig. 2).—Has the wing tubulated. The tubules are in shape like a rose-prickle, springing from a broad base. Each surface of the shell is like an oval or elliptical shield, which overlaps the base of the tubes. The minute circular aperture is in the centre of a narrowly-oval mouth, with beautifully convex, revolute contour. Our specimens have short necks, and differ from *L. ornata* in not having the wing cellulated.

LAGENA LAGENOIDES, variety TENUISTRIATA (Pl. II., Fig. 12); Brady, MSS.—The neck is more produced than in *L. ornata*, and form "oblongo ovate." The variety *tenuistriata* is a Challenger form, finely striate; very rare;† 6 specimens,

LAGENA LAGENOIDES, variety TRIGONO-TENUISTRIATA (Pl. III., Fig. 12), is the trigonal form of the last variety. It bears a considerable resemblance to that of *Lagena ornata* (Will.), but is distinguished by its striæ.

LAGENA BICARINATA (Pl. II., Fig. 4)‡.—This oval form is like the *F. Rizzæ* of Seguenza. It has a median depression between two keels; aperture small, circular in the centre of a rhomboid mouth. This species is allied to *L. ornata*, to which its edge-aspect, as well as its shape and mouth, approach in resemblance.

Seguenza's *Fissurina marginata*, loc. cit., Pl. 2, Figs. 27, 28, page 66, is a compressed form, with a thick keel slightly canaliculate. It approaches the bicarinate form, but we prefer the name given by Terquem § to a more characteristic example.

LAGENA TRIGONO-BICARINATA (Pl. III., Fig. 9).—Very rare; 6 or 8 specimens.

LAGENA FIMBRIATA (Pl. II., Fig. 5); Brady, 1881, Quart. Journ. Mic. Sci., Vol. XXI., N.S., p. 61.—New to British waters; very rare; three specimens.

In confirmation of the views of Parker and Brady, that punc-

* H. B. Brady says:—"The tropical specimens only differ in having fewer stouter costæ."

† This variety has been found elsewhere on British coasts; exceedingly rare (J. S. Wright).

‡ Seguenza speaks of his *Fissurina Rizzæ*:—"Margin white and opaque, therefore distinct from the other portion, which is glassy and transparent"; and of *Fissurina apera*:—"Margin white, keel acute." N.B.—The whiteness of margin in these two species points to the *lucida* type.

§ Terquem, Mem. de la Soc. Geol. de France, Ser. 2, Vol. 2, 1882, p. 31, Pl. IX., Fig. 24.

tuation of surface is of no specific value, we have several specimens of *L. lævis*, *L. faba*, and *L. bicarinata*, which are distinctly and regularly punctate. Had they been striate instead of punctate, it would have been our duty to have given them distinctive names. So much for the importance attached to the nature of surface-ornamentation.

OTHER FORMS.

The NODOSARINE FORMS in this gathering are few in number, and present but little variety.

RAMULINA.—This genus, as constituted by Professor T. Rupert Jones, contained the so-called *Dentalina aculeata* of d'Orbigny and two species, *R. lævis* and *R. brachiata*, discovered by our friend Joseph Wright, F.G.S., in the chalk of the North of Ireland.* To these has been added a recent species, *R. globulifera*, from the "Challenger" dredgings, by H. B. Brady, F.R.S.† This last author expresses surprise that such a true *Dentalina* as d'Orbigny's figure of *D. aculeata* appears to be, should be associated with any Ramuline form. We have in our possession a slide obtained more than twenty years ago from the late Professor Tennant, which bears a printed label—"Dentalina aculeata (d'Orb.), Chalk-marl, Kent." On this slide are four specimens of a subsegmented branching foraminifer, resembling d'Orbigny's species in having the surface aculeate, but otherwise bearing the Ramuline characters of the specimens discovered by Joseph Wright. We mention this in order to show that the error, if it be one, is of long standing.

The Galway material has yielded one specimen only of this genus, Plate IV., Fig. 7. This appears to approach most nearly to the *R. lævis* of the Irish chalk.

It is perhaps worthy of notice that many of the *Ramulinæ*, in form and texture, resemble the cervicorn outgrowths of certain *Polymorphinæ*.

LINGULINA CARINATA, Plate IV., Fig. 6.—Of this rare species two specimens have occurred. The one figured has an entosolenian tube occupying the full length of the last formed chamber. In two respects they differ from d'Orbigny's definition of the species, inasmuch as they are not carinate, and the primordial chamber,

* Proceedings of Belfast Nat. Field Club, 1873, 1874, Ser. 2, Vol. 2, Part 1, p. 88, Pl. III., Figs. 18-20.

† Quarterly Journal of Microscopical Science, 1879, Vol. 19, New Ser., p. 272, Pl. VIII., Figs. 32, 33.

instead of being acuminate, is broadly oval, in these characters resembling Williamson's specimens rather than those of d'Orbigny and Soldani.

CRISTELLARIA CREPIDULA, Plate IV., Fig. 8.—In the literature of the foraminifera no genus is more bewildering than *Cristellaria*. Continental writers, one after another, have heaped up species upon species, until the record of trivial names contains many hundreds, and were we disposed to find a different name for each individual of this species that we have discovered, the task would not be a difficult one, every variety of form being represented, from the short and stout to the long and thin; the chambers of some are short and very broad, whilst those of others are long and very narrow; some specimens are almost straight, whilst others are bent like a fish-hook, but still the same general characters prevail throughout, and proclaim them to be all of the same species. *C. rotulata*, on the other hand, is remarkably uniform in its plan of growth.

POLYMORPHINA.—This genus is well represented, and one of the species, *P. complanata*, d'Orb., Plate IV., Fig. 9, is new to Great Britain, and interesting as being the type of the *Polymorphinæ* which have the chambers arranged in a Textularian manner. *P. myristiformis*, Will., Pl. IV., Fig. 10, is a handsome species, having on a surface like finely ground glass, several perfectly transparent tear-like ribs.

The other species mentioned in the Catalogue being well-known, require no particular comment.

GLOBIGERINA INFLATA, d'Orb., Plate IV., Fig. 11.—The numerous specimens of this species are neat and compact in form, and more Rotaline than those figured by d'Orbigny* or by Parker and Jones.† They present so little variation that they might almost have been made in the same mould.

TEXTULARIDÆ.—Although but five and twenty years have passed since the publication of Williamson's excellent monograph, yet have such changes been made in the knowledge and nomenclature of the British recent Foraminifera, that of the six varieties of *Textularia* therein enumerated, the names of two only remain unchanged, and whilst Williamson then stated that he had not seen any species of *Bolivina*, there are now five species recognised as British.

Of *Textularia* proper we have from Galway three, or perhaps four species. The most abundant is *T. gramen*, d'Orb., which here is arenaceous. Many of the specimens being broader than they are

* Foraminiferes des Iles Canaries, 1839, Pl. II., Figs. 7-9.

† Foraminifera from North Atlantic and Arctic Oceans, 1864, Pl. XIV., Figs. 16, 17.

long, should perhaps be assigned to *T. abbreviata*, d'Orb., which is distinguished only by its shortness in comparison with its breadth.* *T. variabilis* and *T. difformis* are well described by Williamson, and need no comment.

Bolivina.—In this genus we must place the *Textularia lævigata* of Williamson, as it possesses the true Bulimine aperture. Reuss has described a species which appears to be identical, under the name of *Bolivina textilarioides*,† but Williamson's specific name having precedence, must stand.

Amongst the Rotalines we have the species new to Britain, *Pulvinulina scitula*, Brady, Plate IV., Fig. 12.—One specimen only has been found, and this has been identified by H. B. Brady, F.R.S. We quote his description of the species.‡ "A variety of *Pulvinulina canariensis*, differing from the typical form in its relatively small size and compact habit of growth. The margin is rounded instead of sharp and the peripheral ends of the chambers are only slightly convex instead of standing out prominently, as in *P. canariensis*. Notwithstanding its small minute dimensions, it generally attracts attention by its glistening white appearance."

NONIONINA.—Is represented by an immense number of individuals. Besides the species enumerated in the Catalogue, there are forms closely approaching, if not identical with, *N. Boueana*, D'Orb., and *N. scapha*, F. and M., but these require further study before their exact position can be determined.

We cannot conclude without expressing our obligation to H. B. Brady, F.R.S., for the great assistance he has rendered us in determining the species of obscure specimens, and in advising us generally on the difficulties which have arisen in the preparation of this article.

CATALOGUE OF GALWAY FORAMINIFERA.

I.	1.—Cornuspira involvens	... Reuss	...	frequent.
	Biloculina depressa	... D'Orb	...	rare.
	Miliolina tricarinata	... D'Orb.	...	very rare.
	„ oblonga	... Mont.	...	frequent.
	„ Brongniartii	... D'Orb.	...	very rare.

* Foraminiferes fossiles du Bassin Tertiaire de Vienne, 1846, p. 249, Pl. XV., Fig. 9-12.

† Norddeutschen Hils and Gault, 1862, p 81, Pl. X., Fig. 1.

‡ Proceedings Roy. Soc., Edinburgh, 1881-82, p. 716.

		Miliolina seminulum ...	Linn ...	frequent.
		„ subrotunda ...	Mont. ...	common.
		„ secans ...	D'Orb. ...	common.
		„ bicornis ...	W. & J. ...	rare.
		„ fusca ...	Brady ...	rare.
I.	2.—	„ sclerotica ...	Karrer ...	frequent.
		„ Auberiana ...	D'Orb. ...	rare.
I.	3.—	„ tenuis ...	Czjzek ...	very rare.
		Spiroloculina planulata ...	Lamk ...	very rare.
I.	6.—	Haplophragmium glomeratum ...	Brady ...	very rare.
		Haplophragmium canariense	D'Orb. ...	common.
I.	5.—	Haplophragmium globigeriniforme	P. & J. ...	very rare.
		Ammodiscus gordialis ...	J. & P. ...	frequent.
I.	4.—	„ Shoneanus ...	Siddall ...	very rare.
		Trochammina squamata ..	P. & J. ...	rare.
I.	7.—	Trochammina, ochracea	Will. (sp.)...	rare.
		„ inflata ...	Mont. ...	rare.
		„ macrescens	Brady ...	very rare.
I.	8.—	„ plicata ...	Terq. (sp.)...	rare.
		Lagena sulcata ...	W. & J. ...	common.
II.	3.—	„ curvilineata ...	B. & W. ...	very rare, 1 sp.
		„ semistriata ...	Will. ...	frequent.
		„ striata ...	D'Orb. ...	frequent.
II.	2.—	„ Lyellii ...	Seg. ...	very rare.
		„ clavata ...	D'Orb. ...	frequent.
		„ gracillima ...	Seg. ...	rare.
		„ globosa ...	Mont. ...	frequent.
II.	1.—	„ aspera ...	Reuss ...	very rare.
I.	9.—	„ caudata ...	D'Orb. ...	rare.
		„ Williamsoni ...	Alcock ...	common.
		„ squamosa ...	Mont. ...	common.
		„ hexagona ...	Will. ...	common.
I.	10.	„ „ variety ...	... ...	frequent.
II.	7.—	„ lucida ...	Will. ...	common.
III.	4 & 5.	„ trigono lucida (oblonga)	Seg. ...	rare.
II.	6.—	„ lævigata ...	Reuss. ...	rare.
III.	6.—	„ „ trigono lævigata	B. & M. ...	very rare.
II.	10.—	„ faba ...	B. & M. ...	common !
III.	7.—	„ „ trigono faba ..	B. & M. ...	very rare.
II.	8.—	„ quadrata ...	Will. ...	rare.
II.	9.—	„ „ semi alata ...	B. & M. ...	rare.

III.	2.—Lagena marginata	..	W. & I. ...	frequent.
III.	3.— „ „ trigono elliptica		B. & M ...	very rare.
IV.	2.— „ „ quadrigono-Orbignyana		B. & M. ...	very rare.
III.	3.— „ „ var. pedunculata		Seg. ...	very rare.
III.	1.— „ Orbignyana	...	Brady ...	common.
III.	10.— „ „ trigono Marginata	...	...	rare.
II.	13.— „ pulchella	...	Brady ...	frequent.
III.	2.— „ „ trigono-pulchella		B. & M. ...	rare.
II.	14.— „ clathrata	...	Brady ...	rare.
	„ „ variety.	...	...	rare.
IV.	3.— „ quadrigono-clathrata		B. & M.	very rare.
II.	11.— „ lagenoides	...	Will. ...	rare.
II.	12.— „ lagenoides, var. tenuistriata		Brady ...	rare, 6 sp.
III.	12.— „ lagenoides, var. trigono-tenuistriata		B. & M.	
II.	4.— „ bicarinata	...	Terquem ...	rare.
III.	9.— „ trigono bicarinata		B. & M. ...	very rare, 6 or 8 sp.
II.	5.— „ fimbriata	...	Brady ...	very rare, 3 sp.
IV.	6.—Lingulina carinata	...	D'Orb. ...	very rare.
	Nodosaria scalaris	...	Batsch ...	frequent.
	„ pyrula	...	D'Orb. ...	very rare.
	Dentalina communis	...	D'Orb. ...	very rare.
	„ guttifera	...	D'Orb. ...	very rare.
	Cristellaria rotulata	...	Lamk. ...	very rare.
IV.	8.— „ crepidula	...	F. & M. ...	rare.
	Polymorphina lactea	...	W. & J. ...	rare.
	„ gibba	...	D'Orb. ...	frequent.
	„ æqualis	...	D'Orb. ...	frequent.
	„ oblonga	...	Will. ...	rare.
	„ fusiformis	...	Rœmer ...	very rare.
	„ compressa	...	D'Orb. ...	frequent.
IV.	10.— „ myristiformis		Will. ...	rare.
IV.	9.— „ complanata !*		D'Orb. ...	very rare.
	Uvigerina angulosa	...	Will. ...	frequent.
	Spirillina vivipara	...	Ehren. ...	very rare.
	Globigerina bulloides	...	D'Orb. ...	very common.
IV.	11.— „ inflata	...	D'Orb. ...	frequent.

* New to Great Britain.

	Textularia gramen	... D'Orb.	... frequent.
	" variabilis	... Will.	... very rare.
	" difformis	... Will.	... frequent.
	Bolivina punctata	... D'Orb.	... common.
	" plicata	... D'Orb.	... common.
	" lævigata	... Will. sp.	... frequent.
	" dilatata	... Reuss	... frequent.
	Gaudryina filiformis	... Berthelin	... rare.
	Verneuilina polystropha	... Reuss	... very rare.
	Bulimina pupoides	... D'Orb.	... common.
	" marginata	... D'Orb.	... common.
	" aculeata	... D'Orb.	... rare.
	" ovata	... D'Orb.	... frequent.
	" elegantissima	... D'Orb.	... frequent.
	" subteres	... Brady	... very rare.
	Virgulina Schreibersii	... Czjzek	... frequent.
	Cassidulina lævigata	... D'Orb.	... frequent.
	" crassa	... D'Orb.	... rare.
	" oblonga	... D'Orb.	... frequent.
	Discorbina rosacea	... D'Orb.	... common.
	" globularis	... D'Orb.	... common.
	" Parisiensis	... D'Orb.	... frequent.
	" Wrightii	... Brady	... frequent.
IV. 13.—	" orbicularis	... Terquem	... rare.
	" variety	... ...	... common.
	" Bertheloti	... D'Orb.	... very rare.
	Planorbulina Mediterranensis	... D'Orb.	... common.
	Truncatulina lobatula	... Walker	... very common.
	Pulvinulina auricula	... F. & M.	... rare.
	" repanda	... D'Orb.	... very rare.
	" canariensis	... D'Orb.	... very rare.
IV. 12.—	" scitula	... Brady	... very rare.
	Tinoporus lucidus	... Brady	... rare.
	Rotalia Beccarii	... Linn.	... common.
	" nitida	... Will.	... rare.
	Patellina corrugata	... Will.	... frequent.
	Operculina ammonoides	... Gron.	... very rare.
	Polystomella crispa	... Linn.	... very common.
	" striato-punctata	F. & M.	... common.

	Nonionina turgida	... Will.	...	frequent.
	„ depressula	... W. & J.	...	very common.
	„ pauperata	...Balkwill & Wright,		very rare.
	„ stelligera	... D'Orb.	...	very rare.
IV.	7.—Ramulina, sp.	... ...	...	very rare.

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—Cornuspira involvens, Reuss, × 100.
„ 2.—Miliolina sclerotica, Karrer (or contorta, d'Orb.), × 45.
„ 3.—Miliolina tenuis (after Czjzek), × 95.
The Galway examples of this species being wanting in character, we have thought it best to give copies of Czjzek's original figures.
„ 4.—Ammodiscus Shoneanus, Siddell, × 130.
„ 5.—Haplophragmium globigeriniforme, P. and J., × 100.
„ 6.—Haplophragmium glomeratum, Brady, × 220.
„ 7.—Trochammina ochracea, Will. (sp.), × 180.
„ 8.—Trochammina plicata, Terquem (sp.), × 100.
„ 9.—Lagena caudata, d'Orb., × 80.
„ 10.—Lagena hexagona, ? var., × 110.
„ 11.—Lagena quadrata, ? var., × 110.
We figure this curious little hooded variety, as, having found two specimens exactly similar, it may prove to be something more than an accidental variation.

Plate II.

Fig. 1.—Lagena aspera, Reuss, × 80.
„ 2.— „ Lyellii, Seguenza, × 135.
„ 3.— „ curvilineata, Balkwill and Wright, × 85.
„ 4.— „ bicarinata, Terquem, × 100.
„ 5.— „ fimbriata, Brady, × 95.
„ 6.— „ lævigata, Reuss, sp., × 115.
„ 7.— „ lucida, Williamson, × 80.
„ 8.— „ quadrata, Williamson, × 100.
„ 9.— „ semi-alata, nov. × 125.

Fig. 10.—Lagena faba, nov. × 90.
,, 11.— ,, lagenoides, Williamson, × 170.
,, 12.— ,, lagenoides, var. tenuistriata, Brady, × 150.
,, 13.— ,, pulchella, Brady, × 100.
,, 14.— ,, clathrata, Brady, × 140.

Plate III.

Fig. 1.—Lagena Orbignyana, Seguenza, × 110.
,, 2.— ,, marginata, W. and J., × 125.
,, 3.— ,, ,, var., pedunculata, Seguenza, × 110.
,, 4.— ,, trigonal form of lucida, × 110.
,, 5.— ,, ,, ,, ,, lucida, abnormal, double specimen, × 135.
,, 6.— ,, ,, ,, ,, lævigata, × 100.
,, 7.— ,, ,, ,, ,, faba, × 130.
,, 8.— ,, ,, ,, ,, marginata, single keel, × 145.
,, 9.— ,, ,, ,, ,, bicarinata, × 120.
,, 10.— ,, ,, ,, ,, Orbignyana, × 125.
,, 11.— ,, ,, ,, ,, pulchella, × 125.
,, 12.— ,, ,, ,, ,, tenuistriata, × 200.

Plate IV.

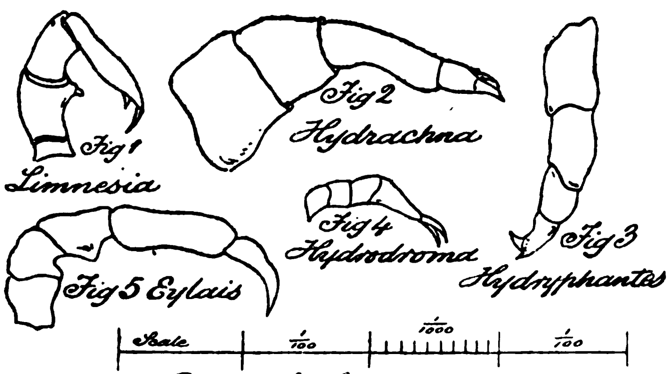
Fig. 1.—Lagena trigono-marginata, P. and J. (arrested growth), × 150.
,, 2.— ,, quadrigono-Orbignyana, nov. × 160.
,, 3.— ,, quadrigono-clathrata, nov. × 160.
,, 4.— ,, Williamsoni, Alcock, var., approaching L. striato-punctata, × 120.
,, 5.— ,, clathrata, Brady (approaching L. castrensis), × 110.
,, 6.—Lingulina carinata, D'Orb., × 80.
,, 7.—Ramulina, sp., × 100.
,, 8.—Cristellaria crepidula, F. and M., × 90.
,, 9.—Polymorphina complanata, D'Orb., × 55.
,, 10.—Polymorphina myristiformis, Will., × 110.
,, 11.—Globigerina inflata, D'Orb., × 85.
,, 12.—Pulvinulina scitula, Brady, × 125.
,, 13.—Discorbina orbicularis, Terquem, sp., × 90.

On the Palpi of Fresh-Water Mites as Aids to Distinguishing Sub-Families.

By C. F. George, M.R.C.S., Lon., etc.

SECOND PAPER.

THE Second Family of the Fresh-Water Mites, **Weihermilben** or HYDRACHNIDES, is divided into five sub-families, viz.—1, *Limnesia;* 2, *Hydrachna;* 3, *Hydryphantes;* 4, *Hydrodroma;* and, 5, *Eylais*, distinguished by having four eyes, whilst the Hygrobatides have but two. If the following figures are examined and compared, they will be found to differ from each other, and also from the figures given with the previous paper,* with the exception of *Limnesia* (Fig. 1), where this organ resembles very closely that of *Hygrobates* amongst the Flussmilben. In Fig. 2 the joints are very wide in proportion to their length, and the movable claw carried on the upper surface of the last joint is very remarkable,



Palpi of Hydrachnides

more so than I have been able to demonstrate in the figure. In *Hydryphantes* (Fig. 3) the organ is small for the size of the mite, and carries the small movable claw beneath the last joint, the upper portion of which projects in the form of a sharp point.

In *Hydrodroma* (Fig. 4) there appears to be two claws, or else

* See "Journal of the Postal Microscopical Society," vol. II., p. 73.

the terminal claw is carried by the side of an equally claw-shaped projection, so that it requires a little management to demonstrate that it is double. In the last figure, that of *Eylais*, the whole organ is more linear than in any other mite. The difference in these organs is much more marked in the specimens themselves than can possibly be shown by my mere outline sketches.

I may just say, with regard to the last family of the fresh-water mites, the **Sumpfmilben**, or Mud-mites, that Koch describes four sub-families, but that hitherto I have only been fortunate enough to meet with one of them, viz., *Limnochares*, and here the palpi are very small, and quite unlike those of any of the swimming mites, also incapable of being used for the same purposes. I should be glad of specimens for examination, if anybody working in this peculiar groove has been fortunate enough to meet with them.

Diamonds and their History.

BY JAMES A. FORSTER.

FIRST PART.

Plate 10.

THE Diamond was probably not known in Europe before direct intercourse with the nations of Southern India had been brought about by the Macedonian conquests. It is not mentioned by Theophrastus in his list of gems. The first indisputable mention of the ADAMAS as the true Diamond, writes Mr. King, "is by Manilius, a poet of the latter part of the Augustan age, who describes its most striking characters, minute size, and enormous value."

There can, I think, be little doubt that the old writers frequently confounded, under the name of Adamas, the Diamond with the Sapphire, Chrysoberyl, Zircon, etc.; but, to again quote from Mr. King, "It is impossible to mistake Pliny's true meaning, especially if attention is paid to the admirably chosen comparisons exemplifying the characters of the gem." King then gives a

translation of Pliny's description of the Indian Diamond as follows:—"It appears to have a certain affinity to crystal, being colourless and transparent, having six angles, polished faces, and terminating like a pyramid in a sharp point, also pointed at the opposite extremities, as though two whipping-tops were joined together by their broadest ends."

The only Diamonds known to the Romans were of small size (from the descriptions handed down to us, probably not above 3 carats' weight), and as they possessed no means of cutting or polishing them, were mounted in their natural forms, many of which are easily recognised from Pliny's descriptions of them under the names denoting from whence they came, as Ethiopian, Macedonian, Arabian. He also describes very accurately the cubic crystal under the name of Androdamas, and the spherical form as Cenchros. In all, Pliny divides his Adamas into six kinds, four of which certainly seem to have been the true Diamond, and two (which he himself rejected as not possessing the qualities of the true Adamas) would appear to have been pale and inferior Sapphires: these he styled respectively "Cyprian and Siderites," and stated that they exceeded the others in weight, which is conclusive proof that they were different minerals.

As the Romans were unable to develop the beauty of the stone by cutting and polishing, they probably esteemed and wore the Diamond rather as a talisman than as a jewel, and were attracted to it by the supernatural virtues attributed to it by the Indians, who have always regarded it with peculiar, and frequently with religious, veneration. This has been forcibly depicted in Wilkie Collins's novel of the "Moonstone," which does not, I believe, at all exaggerate the feeling of reverence that Indians have for many of the remarkable and historic Diamonds; stones that have, indeed, played most important parts in the history of their country and princes. Most notable among such stones is our own Koh-i-noor (see Pl. X.), which the Hindoos consider to possess a genius of "good luck," and also the power of bringing mischief and ruin on those who possess themselves of it by fraud or force; and in confirmation of this they cite the remarkable history of the stone. Indian tradition traces it from the year 57 B.C., when it belonged to Bikramajeet, Rajah of Milwa, where it remained a crown

jewel for ages. It then passed into the possession of the Moguls at Delhi, resting there until the last inroad of the Tartars under Nadir Shah, who, on reinstating his Tartar kinsman on the throne of Delhi, kept the great Diamond for himself. The tale runs that the stone was mounted in the turban worn by the king of Delhi, and on taking leave of him, Nadir Shah, as a mark of friendship, insisted on changing turbans. In any case, it went back with the great conqueror to Persia, with all the fabulous wealth accumulated by the Persian host. On the break-up of his empire after Nadir Shah's death, the Koh-i-noor became the property of Ahmed Shah, king of Afghanistan, as the price of assistance rendered by him to the king of Persia. The gem from that time is very conspicuous in the history of the Afghan princes—always the symbol of power, continually the incentive to treachery and robbery, until it went into exile with Shah Soujah, who, hunted from Peshawur to Cashmere, fell into the hands of Runjeet Sing, the lion of the Punjaub; he, while professing friendship to the unfortunate Dooranee prince, took the opportunity to despoil him of his treasured diamond. It descended to Runjeet's successors, who retained it till the Sikhs were finally overthrown in 1849 by England, when this fateful gem, the talisman of Indian sway, passed into the hands of the East-India Company, who presented it in 1850 to Queen Victoria. Since then it has been re-cut, but unfortunately in such an injudicious manner as to destroy to a large extent its beauty, the stone, in order to preserve its size, having been cut too thin for it to have the lustre and brilliancy inherent to its pure and beautiful material, which is perfection. However, with the disappearance of its ancient Indian form, its baleful influence, we may hope, has also passed away, and that it will henceforth remain an interesting jewel in the British regalia.

In the Middle Ages, the Diamond had come to be valued and to hold the foremost place as a gem for its beauty as well as for the mystic qualities which superstition assigned to it. Principal among these was the power to counteract poison, to ward off insanity, and to inspire courage; further, the Italians attributed to it the power of maintaining affection between husband and wife, for which quality they named it "Pietra della Reconciliazione," and on this account it was used as the most appropriate stone for a betrothal ring.

The Mediævalist workmen, in their scorn for the impossible and love of surmounting difficulties, early endeavoured to overcome the indomitable hardness and irrefragability of the Diamond, and thereby to discover some means of cutting and polishing it the same as other stones. Chemists likewise set to work to discover its nature and to speculate on its origin. The consequent experiments soon bore fruit, and in 1475 Louis de Berquem of Bruges was able to cut three large Diamonds for Charles the Bold. Berquem's invention consisted in the discovery that the Diamond could be polished by means of its own dust, and consequently could be ground away. His appliances were, however, as may be supposed, very inadequate for the task he undertook, and he succeeded in doing but little beyond polishing the natural facets of the crystal, and so developing its brilliancy; succeeding lapidaries, however, improved and perfected his method. About the end of the 16th century, the art made great progress, and in the beginning of the 17th century the possibility of cleaving the Diamond was discovered. This discovery was the most important step till then made towards a thorough knowledge of the Diamond, but it was not until more than a century after that its full value was recognised. I shall refer, further on, more fully to this cleaving, but may here state that the diamond-cutters of the 17th century found they could split a diamond crystal in certain directions, which can be done as easily and with as much certainty as one can split a piece of slate, and availed themselves of this to divide a stone as might be requisite for the improving of its shape or the removal of defects. Scientific men, on their side, had not been idle, and throughout the 17th century experiments were made by French and Italian chemists as to the effect of heat on the Diamond, but without result, and it was left for our own illustrious philosopher, Sir Isaac Newton, to indicate for the first time the true nature of the Diamond.

Newton, in his investigation of the refraction of light by transparent bodies, found that those that are uninflammable refract light nearly in the ratio of their density, while those that are inflammable have refractive powers that are greater than their density. And as the Diamond has a very high refractive power and a comparatively low density, he concluded that it was combustible—

a fact soon to be proved, and he went still further, and wrote that probably it was an "unctuous substance coagulated." By unctuous substance, he meant such as camphor, spirit of turpentine, gums, etc. At a later period, Brewster still further established the connection between a high degree of inflammability and a great refractive force, by the high refractive power he detected in phosphorus.

Towards the end of the 17th century, Boyle, as predicted by Newton, demonstrated that under an excessive heat the Diamond disappeared. A little later, in 1694, a diamond was destroyed at Florence by means of a "burning glass," and the spectators saw with wonder it first become smaller and then entirely disappear, under the action of the rays of the sun. It was not, however, till nearly a century afterwards that the investigation of the nature of the Diamond by the aid of heat was seriously prosecuted. In 1771, before a distinguished company of *savants*, Macquer burnt a fine Diamond in his laboratory in Paris. Immediately a great amount of discussion arose, some experts maintaining that fire had no effect on the Diamond; amongst the most notable was M. Blanc, a celebrated jeweller of Paris, who, to prove his assertion, proposed to submit a diamond to the heat of a furnace for three hours. This experiment was performed in the laboratory of a chemist named Rouelle, and attracted a large number of men of science and jewellers. The stone was placed in a crucible, which was filled with lime, and submitted to the fire, and Blanc had to return home without his diamond, much to the delight of the *savants*. After this, a clever lapidary of the name of Maillard came to the rescue of his *confrère*, and offered to submit three diamonds to any fire, and for any length of time. This challenge being accepted, Maillard placed his diamonds in the bowl of a clay tobacco-pipe, covered them up with charcoal-dust, so as to exclude air, closed the top of the bowl with an iron cover, and placed it in a crucible filled with powdered chalk. This was submitted to such a heat that at the end of four hours the crucible had become a vitrified mass. The fire was then stopped, and on the mass cooling, Maillard, amidst the jokes of the spectators, who recommended him to look up the chimney for his diamonds, broke open the crucible, and there in the centre was the tobacco-

pipe, with its charcoal and diamonds intact. The result of this experiment proved that, while the Diamond disappeared when subjected to a great heat in the presence of air, it resisted the utmost heat that could be applied if air was completely excluded. Once this fact was established, the final solution of the problem of the analysis of the Diamond could not long be delayed, and soon Lavoisier in France, and Sir Humphrey Davy in England, answered, each in his way, the question of "What is the Diamond?" Lavoisier succeeded in burning a diamond in an atmosphere of oxygen over mercury by means of a burning lens, and established by the presence of carbonic acid after the combustion, that carbon was one of the elements of the Diamond. Davy went still further, and showed that as the combustion of a diamond in an atmosphere of oxygen gave rise to nothing else than carbonic acid or carbonic oxide, the Diamond consisted simply of carbon in a state of absolute purity. In fact, it was that element crystallised, and the Diamond had at length yielded to the chemist the secret of its nature, as its form and hardness had yielded to the patience of the lapidary. The Diamond was conquered and much of the mystery enveloping it dispelled, but there yet remained to be discovered its origin and true geological position. Before, however, entering upon this question, it will be well to consider carefully the Diamond as a mineral, and to make ourselves acquainted with its form and characteristics.

The Diamond belongs to the tesseral or cubic system, having three axes at right angles, and occurs in many different forms and appearances. So dissimilar, indeed, are some specimens from the normal type, that the uninitiated would hardly suppose they could be the same substance. It is found as crystals of various shapes and of every colour, also in more or less crystalline masses of no special or definite form. This variety is known as Bort, and is of no use as a gem, being so flawed and knotted in its formation as to be almost, or quite, opaque. It has, however, its value, being of great importance in the arts and for mechanical purposes. Besides the crystallised forms, there is an exceedingly curious and interesting variety, almost amorphous, that is called Carbonate, occurring in broken pieces, opaque, black, reddish, or grey, and very rarely showing traces of crystalline structure. In appearance

it is much like broken chips of hæmatite; of course, it is identical, chemically, with the crystalline Diamond, but excepting its supreme hardness, it possesses little to remind one of a Diamond. The Carbonate is found only in Brazil, and is much valued and employed for engineering purposes, especially for rock-boring, for which purpose it is preferable to the crystallised Diamond, being less liable to split when subjected to great pressure or concussion.

It would be impossible, in the limits of this paper, to describe the various uses made of Bort and Carbonate, but their importance will be indicated by the fact that selected pieces are mounted as turning-tools for the turning of chilled steel rollers, emery-wheels, stone, and such excessively hard substances as defy the finest chisels that can be manufactured, thus avoiding, to a large extent, the slow and laborious process of grinding by emery. It is also mounted on rollers for the purpose of dressing mill-stones, and, perhaps most important of all, it is made, as stated above, into drills for rock-boring (see Plate). These drills are composed of a steel ring, in the edge of which pieces of bort or carbon are embedded. The ring is fastened on to the end of a steel tube, which is made to revolve against the surface of the rock by steam power, and as the drill grinds into the rock, it is lengthened by screwing fresh steel tubes into the original one. Very deep borings (it is stated over 2,000 feet) can thus be effected very rapidly. A good tool will pierce hard granite at the rate of three inches per minute, and so through many thousand feet, without serious wear taking place. Of course, great pressure is required, and the Diamonds have to be kept cool by the pumping of water through the tubes. The inferior kinds of Diamond are also crushed to make diamond-powder, for which there is a very large and increasing employment.

The Diamond is usually described as crystallising in some half-dozen separate and different forms. This is certainly inaccurate, for, however dissimilar diamond-crystals may be in appearance (and an almost infinite variety of very beautiful and distinct forms occur), yet they are all reducible to the simple normal form of the regular octahedron, from which the most complex forms are built up according to a simple and definite law. Nature would seem to have done her utmost to

puzzle the mineralogist with a multitude of beautiful geometric shapes, among which it is indeed difficult to know where to begin. We have a crystal of eight triangular sides, with sharp angles and straight edges, in form like two square pyramids, joined base to base; this is the regular octahedron; we have one of 6 sides, a perfect cube; another with curved edges and 24 sides; another with 12 sides; another of the shape of a cocked hat, having an irregular edge, this is a double crystal or twin. Some have their sides beautifully smooth and polished; others striated, or covered with little triangular pits, and presenting a grey, semi-opaque appearance; some are coated with a dense colouring matter that appears to have entered into the outer layer of the crystal, and effectually prevents the interior being seen. Very frequently, a stone so coated, and appearing, when found, deep green and semi-transparent, on being cut produces a fine brilliant of the purest white. These regular forms are, however, comparatively rare, as by far the greater part of the Diamonds found are broken chips and fragments of every possible shape. All this multitude of different shapes are, however, as stated above, derived or built up from one normal form, the regular octahedron. The question will be asked, "Why should the octahedron be considered the normal form any more than another—say the cube?" The answer is, that the cube can be cleaved into the octahedron, but the octahedron cannot be cleaved into the cubic form. For this reason, that whatever is the shape of the Diamond, the cleavage planes are always the same—viz., in four directions parallel to the four pairs of faces of the octahedron, and in no other direction is it possible to split a Diamond. It consequently follows that in cleaving (see Plate) one can only produce faces of an octahedron. The process of cleaving might fairly be called unmaking a Diamond, for as Nature has built up the crystal layer upon layer, so the cleaver takes off layer after layer till he lays bare the original shape.

The Diamond, being of the tesseral system of crystallisation, has consequently three equal axes intersecting each other at right angles, and around these three axes the ultimate carbon atoms that are to form the crystal, group themselves according to an invariable law, in triangular laminæ, resting at definite angles with

the axes, and forming planes that are the planes of the octahedron; and it is only by laminæ laid on these octahedral faces that increase takes place. It is, therefore, evident that if additions are made to some faces of the original crystal and not to others, the shape of the crystal will be altered; also, if a series of laminæ, decreasing gradually in size, are piled up on the triangular faces of an octahedron, each face will be trisected, and the octahedron crystal changed into a crystal of 24 sides (see Plate). So it is with all other forms; they are all built up by additions to some or all of the original faces of the octahedron.

I have spoken continually of cleaving, and should perhaps have explained the process before. First, a cleavage plane is found by examination of the surface-indications on the stone; then, having ascertained the directions in which it is possible to cleave the stone, the workman fixes it by means of cement on a handle. This he holds in his left hand, and with a sharp splinter of Diamond, similarly fixed in a handle held in his right hand, he abrades on the Diamond to be cleaved a small notch over the plane through which he intends to split. This done, he places the edge of a knife in the notch, and a gentle tap causes the diamond to separate. Although it is so easily split in this manner, yet a heavy blow from a hammer would probably fail to break it.

Having considered the outward form of the Diamond, there remains its physical qualities to be investigated. First in importance is its hardness, which distinguishes it at once from any other stone. It is the hardest substance in nature, and can only be scratched by itself, while by it everything can easily be abraded. It is this quality of supreme hardness that gives the Diamond its value to the engineer for rock-boring, the glazier for glass-cutting, the miller for dressing his mill-stones, and the lapidary for cutting other stones.

The specific gravity of the Diamond is 3·55, being characteristically light (although so much harder, it is lighter than the Sapphire). This, in conjunction with its great refractive power, as before stated, first led to the theory that it was combustible. Of its optical properties, I have not space in this paper to say more than that it refracts light more than any other gem, which quality, with its capacity, thanks to its hardness, of receiving the brightest

possible polish, is the chief cause of its beauty as a jewel. When subjected to friction, it becomes highly electric, and after being exposed to the sun or to a galvanic current, it is said to show phosphoresence in the dark.

(To be continued.)

A Bit of Groundsel.

By Rev. H. W. Lett, M.A., Trin. Coll., Dub.

Plates 11 and 12.

"FAR-OFF cows have long horns" is applicable to the ideas of many a possessor of a microscope; the cabinet, conversation, and practice of such showing that little is thought of any "object," unless it be of select—perhaps *Challenger* reputation; whereas the weeds and pebbles crushed under foot every day can furnish work for many a night, and thoughts for weeks to come.

> "A wayside plant, a common weed,
> Will furnish all that we can need."

To illustrate this philosophy, let us take a bit of common Groundsel—*Senecio vulgaris*—so well known as a favourite food of the bird-fancier's pets, examine it microscopically, and see something of what may be added to the descriptions given in the ordinary works on common flowers.

Groundsel, being a native of Northern Europe, and found in all cool climates, and flowering nearly all the year round, can be easily procured. It is also a typical representative of the largest and most complete natural order of plants, viz.—the *Compositæ*, all of which are herbs or half-shrubs. Their flowers are crowded together in dense heads upon a common receptacle, surrounded by an outer, close-fitting, calyx-like involucre (Plate XI., Fig. 8). Each of these heads or colonies of flowers is a veritable fairy bouquet, ready in its holder for Queen Mab to pluck. It will be

found that the crowding of flower-heads on a common stalk is by no means limited to the one natural order to which Groundsel belongs, but may be traced through various stages of development in clover, in the umbel of hemlock, in the corymb of the cherry, and in the panicle of grasses. For if we crowd these flowers close together without their stalks, we have an exact representation of the flower-head of the daisy and groundsel.

To begin with the hoary head of seed-down, whence the name *Senecio*, from *senex*, an old man; each white fibre of this shuttlecock by which the ripe seed is dispersed by the wind is slightly waved, and has serrated edges (Plate XI., Fig. 4); when moistened with water, it will be seen, under $\frac{1}{4}''$ o.g., to be hollow, and to have a branched tube opening out of each tooth. Before the ovule is fertilised (Plate XI., Fig. 1), this down, or pappus, is pressed close to the little yellow corolla, being, in fact, the modified calyx. As soon as fertilisation has occurred (Plate XI., Fig. 2), and the ovule begins to swell into a seed, the pappus becomes larger, and the tiny corolla falls out of the middle of the bunch of hairs, which is then ready spread, and floats off with the seed on the first breeze.

The seed is somewhat oval, and, as the text-books describe it, "ribbed and silky" (Plate XI., Fig. 3). With a 1-inch o.g., longitudinal bands of alternate yellow and brown may be discovered on the seed, the brown portion bearing small, blunt hairs which point upwards, the yellow bands being formed of longer and more slender hairs, lying quite flat when dry (Plate XI., Fig. 5). When wetted with a drop of water, they will rise up, straighten themselves, and stand out at nearly right angles from the seed. A few globules of oil may be noticed when a portion of a seed is crushed in the field of view.

The pollen (Plate XI., Fig. 6) is nearly globular, with three principal, and many minute, projections, and will be found a much severer test for the defining powers of an objective than the popular mallow pollen. And the pollen tubes (Plate XI., Fig. 7), which penetrate through the style down to the ovary, and fertilise the ovule or embryo seed, can be found in all stages of growth on almost every stamen. The heads of the Groundsel flowers become conical after fertilisation (Plate XI., Fig. 8). This is

caused by the enlarged growth of the cells on the end of the flower-stalk. A like process, but on a much more extensive scale, produces the edible heads of the garden artichoke (*Cynara scolymus*), and the luscious strawberry. The stamens which produce the pollen-dust are found in all the *Compositæ* within the tube of the corolla; and their anthers are united into a tube which encircles the style, whence the plants belonging to this natural order are called in the Linnæan system *Syngenecious* (Plate XI., Fig. 10).

The style (Plate XI., Fig. 9) is well worth attention. It is slender and thread-like, and split at the top; the two portions curving away from each other. The tips and upper surfaces of these are densely set with little processes, from which is exuded the sticky substance that retains the pollen when it falls upon it. It is evident that the position of these processes on the *upper* with none on the *under* sides of the stigma, is to ensure cross, and to prevent self fertilisation.

Let us next take the stem, which is channelled or streaked with longitudinal lines, and, as seen in the transverse section (Plate XII., Fig. 2), slightly angular; botanical books describe it as "glabrous, or bearing a little loose cottony wool." This "wool" is found chiefly on the young parts—in the forks of the branches and leaves, and is of the nature of trichome or plant-hairs; here it is a string of cells, like glassy beads (Plate XII., Fig. 8), and is similar to the larger hairs of the common Sow Thistle, *Sonchus palustris*.

If we now make a transverse and also a longitudinal section, and note the arrangement and shape of the cells in each, we shall see that all are nearly cubical, except those of the cuticle, which are six times longer than they are wide. Here are to be observed the three systems of tissues, viz.—(1) the epidermal, (2) the ground, and (3) the fibro-vascular. 1.—The epidermal tissue, there being no bark (Plate XII., Fig. 3 and Fig. 1 *a*), is one row of long and flattened cells. 2.—The ground or fundamental tissue (Plate XII., Fig. 4 and Fig. 1 *b*), some of the cell-layers of which are filled with purple colouring-matter immediately outside the fibro-vascular bundles. The cells of the ground tissue gradually increase in size towards the centre of the stem, till they are rup-

tured (Plate XII., Fig. 2), and the centre is left vacant, thus affording an excellent example of how the stems of many plants become hollow. 3.—The fibro-vascular tissue (Plate XII., Fig. 1 *c* and Fig. 2), in bundles more or less numerous, but where our section was cut numbered twenty-six, and arranged with the smaller and younger bundles alternating with the larger. Their division into xylem or woody matter and phloem, or portions wherein addition and increase take place by growth, is easily distinguished, without having resort to the double staining so needful in many cases.

The polariscope will afford much assistance in examining these sections, and while noting the various arrangements and forms of the cells, we shall find that the longitudinal section of a stem of Groundsel is a much more beautiful polariscopic object than dozens of the ordinary polarising slides. The sections made while preparing this paper were cut slightly oblique with a razor and mounted, for the time, in a few drops of water. The leaf did not polarise at all. A transverse section showed an epidermal layer of small cells, containing no chlorophyll (Plate XII., Fig. 5). This causes the slightly crystalline appearance of the upper side of the leaves. Beneath this epidermal layer is a thickness of five or six cells, full of chlorophyll, whose rounded form is owing to freedom from compression. The under-surface of the leaf consists of map-shaped cells, among which are the stomata opening into large air-spaces (Plate XII., Fig. 6). A 1-inch o.g. showed the stomata very well.

No crystals or lactiferous vessels could be discerned in the stem or leaf, and no trace of starch appeared in any part of the plant in answer to the iodine test.

Under a ¼-inch o.g., a root-fibre was a very interesting object, having a canal in the centre (Plate XII., Fig. 7), bordered by spiral vessels continued to the root-cap, and was quite transparent with ordinary light.

On the leaves were found two species of fungi, *Peronospora gangliformis* (Plate XII., Fig. 9), a white mildew, covering the under side, the tips of whose branches are in an umbel, while the spores are globular. Nothing can be more lovely than a colony of this fungus, seen with a ½-inch o.g., and Lieberkuhn. It is a

perfect forest of silvery fruit-trees, the stalks of which twist in drying, the spores being discharged by the action. This parasite is very common on Groundsel in July and August. The other fungus, *Trichobasis senecionis*, is not so frequently met with. It is found as a reddish rust occupying all the under-surface of the leaf.

This description by no means exhausts all that could be got out of a "bit of Groundsel." Let anyone try it, and the exclamation is sure to be, "The half was not told me." The writer has endeavoured to show something of what may be found to study with the microscope in a common wayside weed.

EXPLANATION OF PLATES XI. AND XII.

PLATE XI.

Fig. 1.—Seed of Groundsel before fertilisation.
,, 2.—Seed of same after fertilisation.
,, 3.—Seed of same, × 20 diam.
,, 4.—Hair of pappus, × 20 diam.
,, 5.—Short and long hairs from seed, × 100 diam.
,, 6.—Pollen, × 400 diam.
,, 7.—Pollen, with tube partly grown.
,, 8.—Heads of flowers before (*b*) and after (*a*) fertilisation.
,, 9.—Stigmas and part of corolla, × 100 diam.
,, 10.—Stamens and part of style, × 100 diam.

Drawn by H. W. Lett.

PLATE XII.

Fig. 1.—Part of longitudinal section of stem of groundsel:—(*a*) epidermal tissue; (*b*) ground tissue; (*c*) fibro-vascular tissue, × 50 diam.

,, 2.—Transverse section of stem of same, × 20 diam., showing ruptured cells in centre, and arrangement of fibro-vascular bundles.

Fig. 3.—Transverse section of part of epidermal tissue, × 50 diam.
,, 4.—Ditto ditto ditto ground tissue, × 50 diam.
,, 5.—Transverse section of part of leaf, × 100 diam.
,, 6.—Under-surface of leaf, with stomata, × 100 diam.
,, 7.—Tip of a rootlet, × 280 diam.
,, 8.—Hair from stem, × 20 diam.
,, 9.—Fungus, *Peronospora gangliformis*, or mould on leaf of Groundsel, × 100 diam.

Drawn by H. W. Lett.

An Inexpensive Turn-Table.

BY E. J. E. CREESE, F.R.M.S.

SOME time ago, a few creditably-mounted Microscopical Slides of Wood Sections were submitted to me for inspection, with an apology for their having been "finished" under unfavourable circumstances. These were—that the mounter (a member of the local Microscopical Society with which I am connected) having lived in a village, had there to construct and find his mounting apparatus, and did not possess a turn-table.

This suggested to me the feasibility of constructing a "home-made" turn-table, which anyone with ordinary knack can make for himself at the cost of a shilling, and of which I will give a brief description.

The materials are easily obtained, and it will be found to work very satisfactorily. A, B, C (Fig. 1) are three pieces of hard wood, cut out and put together to the pattern shown. The length of A and C is 9 inches, and the height of B is regulated by the length of the arbor, E. D is an old, heavy clock-wheel of nearly 3 inches diameter, which may be obtained of any clock maker for a few pence, or at a gift, inclusive of rust, dust, and cobwebs. This wheel is always supplied with an arbor, E, attached, which measures 2 to 3 inches in length. F is a little grooved wheel.

FIG. 1.

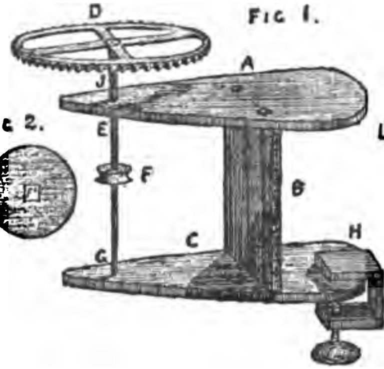
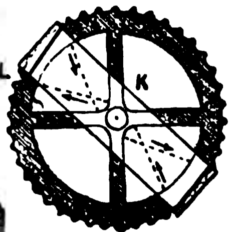


FIG. 2.

FIG. 3.



which can be squared on the circular-shaped arbor (as at F′, Fig. 2) by the use of a file, and then fixed by a small wedge. J is a hole in the upper piece of wood that forms the hand-rest, and should be carefully bored, G being a small hole in the lower piece of wood into which to let the smoothly-filed and pointed end of the arbor. H is a clamp for fixing to an ordinary table or board, and can be bought for a few pence, or made at home. To rotate the table, a bow such as watch-makers use, should be constructed, and the stretched string passed round the grooved wheel (as at M, Fig. 2), the bow being worked backwards and forwards with the left hand, whilst the right hand is employed in finishing the slide. Fig. 3 shows how the glass slip is attached to the wheel. At L a deep notch is cut in the circumference of the wheel, and a piece of string, 10 inches long, attached at one end, being kept by a knot, on the under side of the wheel. The slip K is then centred as accurately as possible and the string brought over the top, then under the wheel, following the directions of the arrow-heads, over the other end of the slip, and again under the wheel, until it is *brought over* the deep notch at L and secured by a second knot already made at the other end of the string. It will be found convenient to cut 8 of these notches upon the circumference of the wheel at equal distances from each other.

I submit this simple and inexpensive turn-table in the hope that it may serve those who, like my friend, are willing, but unable to indulge themselves with the materials by which properly to prosecute their loved work of mounting preparations for microscopic examination.

Stylops.

By V. R. Perkins, M.E.S.L. Plate 13.

THAT the Stylopidæ are a very interesting as well as a very peculiar family of insects, there can be no doubt whatever. When the first specimen of *Stylops* was discovered by Kirby, he was completely puzzled as to what order it belonged, and after a most critical examination of its structural characteristics, he thought it remarkable enough to found a new order for its reception—the order of STREPSIPTERA, or twisted-winged, from the peculiar twist taken by their anterior wings, if such they can be called. This order was placed next after the HYMENOPTERA. It is composed of a very small group, three species only occurring in England, all of small size, the largest not being a quarter of an inch in length. These insects are what are termed personal parasites—that is, they live within the body of their victim, the wild bee; but as their structural characters vary slightly with regard to each other, they are divided into as many genera as species.

The general character of the perfect insects indicates great weakness, and consequently their life is of very short duration, limited in all probability to a few hours only. Their whole structure, however, is very remarkable. The eyes, from which the typical genus takes its name, are very large, lateral, and prominent, and being placed upon the contracted sides of the head, give them the appearance of being pedunculated; besides this, they have remarkably few facets. The mouth is equally singular; Westwood, who has examined and dissected several, tells us he has not been able to detect any oral aperture whatever, and therefore it is very probable that the perfect insect requires no food during its short existence. The mandibles, maxillæ, and labium are all so extraordinary as to have caused the Stylops to be placed by different naturalists in almost every order of the insecta: Hymenoptera, Diptera, Orthoptera, Lepidoptera, and

Coleoptera; in short, both among the Mandibulata and the Haustelata.

Their antennæ are either branched or flabellate. In this they resemble many Coleoptera and Hymenoptera; and as the insects in these two orders which have similar antennæ are always *males*, so Westwood considered his specimens to be males also. Their peculiar labium united them after the same method of reasoning with the biting Diptera. The thorax is, perhaps, still more peculiar. It is very long; in fact, simply enormous for the size of the insect, and the greatest part being made up of the meta-thorax, it appears quite to overlap the basal joints of the abdomen. Attached to the meso-thorax are two very curious appendages, like twisted wing-cases, which are really the anterior wings, whence the name of the order; while the posterior wings are out of all proportion large, and in repose close up over the abdominal segments in longitudinal folds like a fan. The tarsi are four-jointed, and instead of claws are furnished with soft cushions, which enable the insect to cling firmly to the abdomen of the bee.

After being bandied about from one order to another, they are now in Sharp's Catalogue resting among the Heteromerous Coleoptera, and following immediately after the Mordellidæ, How long they will remain there, who can tell?

Having said so much about their structural appearance, the next thing is to know when and where to look for them. As they are parasitic upon the wild bee, they must, of course, be sought for upon their victim. But they will not be found upon all wild bees; on the contrary, they are very limited in their selection. Why, we cannot tell; but so it is. The species most frequently found Stylopised is *Andrena atriceps*, though several others of the same genus come in for a small share of their favour. The *Atriceps* is abundant throughout the London district, and is particularly plentiful on Hampstead Heath. It is one of the very early spring bees, and may be seen on the wing about the first week in April, if not earlier, so that entomologists who wish to add this interesting and peculiar insect to their collections must lose no time in seeking for it; and I may also add, that if they want specimens of the male *Stylops*, they must be very early in the

field, for they make their escape from the body of the bee almost as soon as the bee begins its flight. The brighter the morning the earlier it will be out. From 9 to 11 a.m. is the best time, and after the turn of the day it would be almost useless to attempt to find it, unless the weather were dull and showery.

There is a very interesting record in "The Entomologist's Monthly Magazine" of the capture of a number of *Atriceps*, stylopised, at Hampstead Heath, by Mr. Enoch, on the 5th and 6th of April, 1875. On those two days, he captured 46 specimens of that bee, and from these he obtained no less than 59 specimens of *Stylops*—19 males and 40 females. These were all afterwards bred from the bees in captivity, some of which, he tells us, did not emerge for 20 days; a very long time to keep captive bees alive. On these two days he only saw one *Stylops* on the wing, and his description of its flight was as follows:—"A little before 11.30, I saw something flying in a very peculiar manner over a broom-bush. I captured it with my net; it proved to be a male *Stylops*. I think I should now know a *Stylops* on the wing the moment I saw it. Its flight is different to anything else I have ever seen—a very peculiar, unsteady flight, something like an ephemeron, or what I should call an uncomfortable flight up and down, this way and that way; in fact, at all angles, not keeping in one direction apparently for more than 6 or 7 inches."

Another entomologist tells us, that after capturing one on the wing, he on another occasion saw about 20 flying, but they were so high from the ground he could only capture half-a-dozen. The little animals are exceedingly graceful in their flight, taking long sweeps as if carried along by a gentle breeze, and occasionally hovering at a few inches from the ground. Their expanse of wing and mode of flight gave them a very different appearance to any other insect. When captured, they are exceedingly active, running up and down the sides of the bottle in which they are confined, and moving their wings and antennæ very rapidly. Mr. Dale also tells us that *Stylops* flies with an undulating or vaccilating motion, and one he caught ran up and down, keeping its wings in motion, and making a considerable buzz or hum, as loud as a *Sesia*. It twisted its rather long tail about, and twined it up

like a *Staphylinus.* He put it under a glass, and placed it in the sun, where it became quite furious in its confinement, and never ceased running about for two hours. The elytra, or processes, were kept in quick vibration, as well as the wings. It buzzed against the side of the glass, touching it with its head, and tumbled about on its back.

So much for its appearance on the wing. Now, how do we know when a bee is stylopised? If, upon examining the upper segments of the abdomen of the bee, we find a slight incrustation or protuberance on the fourth segment; that is a sure indication of the fact. Kirby, who first noticed this protuberance, mistook it for an Acarus, and in order to examine it more minutely endeavoured to disengage it with a pin. "What was my astonishment," he says, "when I drew forth from the body of the bee a white, fleshy larva a quarter of an inch long." This white, fleshy larva is now known to be the female *Stylops.* She is simply a white, fleshy maggot, without the least trace of legs or wings, furnished only with a flattened, horny, anterior extremity, which enables her to push through the segments of the bee's abdomen, and just below this horny plate is a transverse aperture, through which the male fecundates the eggs, and afterwards the young larvæ emerge. The eggs can be seen through the body of the female, and the eggs are hatched in this situation. After having extracted this larva or female, Kirby attempted to extract a second, but now his astonishment was greatly intensified, when, instead of getting out another larva, the skin burst as he was extracting it, and a head as black as ink, with large, staring eyes, and antennæ consisting of two branches, broke forth, and moved itself from side to side. It looked like a little imp of darkness, just emerging from the infernal regions. This was, of course, the male, as the first was the female *Stylops.*

The number of eggs laid by the female is very considerable. The little larvæ, when first hatched, are hexapods, and very active little creatures, quickly making their way out of their mother's body by the transverse aperture mentioned above. Smith tells us he has several times bred these larvæ by keeping the infested bees in confinement, and supplying them daily with fresh flowers, such

as the bees frequent. If the bee is examined daily, it is probable that within eight or ten days she will appear as if her abdomen were covered with dust. Examine this with a microscope, and in all probability she will be covered with an innumerable quantity of minute animals. These are the larvæ of *Stylops*. At this stage of existence, their four anterior legs are each furnished with a pad (like the perfect male), by means of which they can run freely over the abdomen of the bee. Now, as the bee flies from flower to flower to feed, some of these little creatures get brushed off with the petals, and so get left behind, until other bees come and visit them, when they attach themselves to the next comer, and so get carried to the nest. Here they attach themselves to the larva of the bee, and bury themselves in it by degrees, soon losing their legs, and becoming now maggot-like creatures, and remain feeding on the substance of their victim till both arrive at maturity. Judging from the multitudes of larvæ produced by each female *Stylops*, and the rarity of the perfect insect, immense numbers—in fact, the majority—of these larvæ must perish, as generally only one, and seldom more than two, are found to infest the same bee.

The last peculiarity to be noticed is that these parasites do not, like the *Chrysididæ* and *Ichneumonidæ*, destroy the victims on which they feed, but, on the contrary, the larva which nourishes the parasites undergoes its metamorphoses in the regular way, and the bee comes forth to all appearance perfect, with its enemy still in its abdomen; and as it flies about and feeds exactly like other bees, the only important injury inflicted being the prevention of the development of the generative organs, and the consequent sterility of the bee. On this account, in all probability, the appearance of the bee is somewhat altered, the colour of the pubescence undergoes a change, and, as a consequence, stylopised bees have been added to the lists as distinct species. The attention that has been bestowed on this subject lately, and the searching examinations that have taken place, will probably cause all such to be removed. It is now well known that stylopisation causes the pubescence in brown bees to become grey, and renders the males more like the females in colour and appearance.

The bees most frequently attacked by the *Stylops*, and which

are most likely to be met with in the south of London, are *Andrena atriceps*, *A. Trimmerana*, *A. nigroœnea*, and *A. Afzeliella*. The first three are very generally distributed and often abundant.

EXPLANATION OF PLATE XIII.

Fig. 1.—Stylops, (? sp.) male.
,, 2.—Ditto, female.
,, 3.—Ditto, in its early larval state.
All very much magnified.

Half-an-Hour at the Microscope,

With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

Sting of Scorpion.—Just at the outlet of the canal for the poison, some small masses are present. With the highest available power and the polariscope, my friend, A. Nicholson, proved to my satisfaction that these were crystals of Oxalic, or (as I think) some Isomeric Acid, infinitely more deadly. Correlating Lewis G. Mills's observations of crystals at the outlet of the poison-canal in the falces of a Spider found by him, I think it not unlikely that in hot, dry seasons, similar crystals might be found in the stings of Nettles, of *Loasæ*, and other urticating plants. Who of our members will undertake such an inquiry? To obtain the requisite knowledge of what to examine, botanical text-books would, of course, have to be consulted. The fangs of Poison-serpents might be expected to yield similar crystals—another most interesting inquiry for those who will, to take up.

Naphthaline.—The contributor would oblige more than one country member by a few particulars as to what this substance is, whence obtained, and where to be procured. It is considered by Prof. Williamson, of Manchester, to furnish the very best of all substances for imbedding delicate microscopic subjects in, previous to cutting sections. The crystals are both pretty and interesting. The *lines* of crystalline deposit seen in parts are due to minute scratches on the surface of the glass. How delicate

the play of elective affinity between the two edges of a scratch! Exquisite mountings might be obtained by delicate geometrical patterns cut with the diamond-writing machine. Who will try this?

Ophiocoma neglecta.—Members visiting Southend, Margate, Ramsgate, Deal, Dover, etc., and probably any of our sandy sea-shores, would find a search for these richly rewarded. The *Echinodermata* generally furnish no end of instructive and beautiful preparations. To know what to look for, and how to look, read Forbes' "British Star-Fishes," and then set to work.

Calcedony is a type of a good class of objects, from which much interest and instruction are to be derived, namely—as illustrating microscopically the intimate structure of geological and mineralogical specimens. The physical conditions under which they were formed present problems of the grandest order. David Forbes, whose writings are unfortunately scattered through various periodicals ("Popular Science Review" and "Proceedings of the Geological Society" are the most accessible), is the pioneer and almost the only worker. I must warn my fellow-members, however, that such slides are at the present very difficult to prepare, from their extreme hardness, and most of us will prefer paying a visit to the opticians, and choosing for ourselves an illustrative series from their admirable collections.

Those who wish to learn about Calcedony must read J. Morris on "The Gems and Precious Stones of Great Britain," in "Popular Science Review," April, 1868, p. 123.

Seeds of Typha latifolia have evidently been mounted by a novice, from a specimen in excellent condition. One, two, or, at most, three seeds should have been picked out carefully with the forceps, and laid side by side, instead of the confused mass here presented to the eye, from which it is tedious, even for an expert, to gain the facts intended to be displayed. The specimen is a highly interesting one. The part above the elongate oval seed is the style, or remanet of the pistil, and would probably furnish a capital subject for observation of the descent of the pollen-tubes. The fruit is elevated on a long, slender stalk (Pl. XIV., Fig. 7), probably an elongate disc. The hairs at the base represent the perianth; they are about 36 in number, and may be considered as composed of three whorls, of 12 in a whorl, equivalents of petals, sepals, and bracts. The genus is closely related to the *Araceæ* (type, *Arum maculatum*, "Lords and Ladies"), and to the Screw Pines. Every part contains abundance of prismatic raphides. I should like to see fruit of the Lesser Bulrush (*Typha Augustifolia*); the plant is of occasional occurrence throughout

the country. Sowerby describes and figures a third species, *Typha minor*, as found in Britain. This it would be very interesting to see—no matter, in a micro-scientific point of view, whether "doubtfully British" or no.

Head of Cockroach; Gizzard of Cockroach.—I place these together as types of a most important class of slides—such, namely, as illustrate well the structure of the common objects by which we are surrounded. It is of far more essential importance to us that we should be familiar with the objects connected with our daily life, than with such as we may see but at rare intervals, and comparatively few ever at all. The same watchful Providence and the same beneficent design are exhibited in the homeliest as in the rarest objects. And if we act "Her Majesty's Commissioner on Education," to our consciences, how little is there we know of even such things as the Lesser House-Fly, the Cockroach, or the Cricket! *Know*, that is, in the sense of real insight into their life-history—from the egg to the grave—as compared with what we might gain by a moderate exercise of pains and thought. The lessons to be learnt from them are full of as profound interest and true wisdom, as from any study that man can pursue. What is the history, from the egg to maturity, of this, that, and the other? let us ask ourselves; and when we really do know all that is to be learnt by the microscope about them, we shall have acquired powers of observation and reasoning, and a mass of accurate facts, which will astonish ourselves and others as well, and be able to add largely to the stores of communicable knowledge to be found as yet only in books.

To the Gizzard we must accord a unanimous welcome. It is so interesting to see the mill of one of these atrociously voracious creatures. And in its simplicity, it furnishes so good a key to the more complicated forms met with in some others of the Insect tribe.

In preparing it, what do we find? Why, there's first next the mouth a capacious thin-walled bag, the Crop, destined principally for the reception of food. And how large it is in the vegetable-feeders, the earwig and the grasshopper to wit! Then we come to the Gizzard, which may be likened to a pudding-bag, of somewhat triangular outline (see Pl. XIV., Fig. 8). *a*, End of Crop; *b*, Gizzard, in profile; *c*, Œsophagus, hexagonal in section (see Fig. 9), with six powerful teeth, the points towards the wide receptive apex pointing inwards. Between each of these is a tendon of a fan shape. These serve to give strength to the walls, and *points d'appui* for circular bands of muscular fibre; outside these cross-muscles are longitudinal ones, very short and strong. By their combined action the mill is set in motion and kept going

(the food being passed on as it becomes reduced) to the first or œsophagal portion of the intestine. Till this slide met my eye, I had never seen any other preparation of the structure than one I made amongst my first attempts, now some 30 years ago. Yet it makes a most interesting, pleasing, and instructive slide. It shrivels rather when mounted dry. The Gizzards of insects, taken up as a systematic study, will furnish endless sources of instruction and delight. Little has been published on the subject. Who will go in for them?

Cercopis sanguinolenta is a fine example of the class of slides to which it belongs—entire insects. These, though not *altogether* satisfactory to the student, are highly attractive, interesting, and calculated to bring into the ranks of workers with the microscope some who may have previously given such subjects little thought.

The antennæ, three-jointed, should be carefully examined, the facetted eyes, the forehead, the wings, the limbs, with their powerful claws and the terminal suckers, each having a tactile hair distad in the centre. The robustness of the limbs, the number and form of the tarsal joints, the curious and complex spurs on the outer edge of the posterior tibiæ, also at the distal ends of the same joints, *alternately fixed and moveable*, the spurs at the extremity of the first two tarsal joints in the same limbs. All these having a long tactile hair on the inner edge near their extremity, these, with the spiracles, are the most noticeable facts to be learnt from this valuable slide. The parts of the mouth are not well seen, but one of the outer pair of four setæ, (a modified mandible,) may be clearly made out; also, the three-jointed sheath —case for surgical instruments, it may be called—or "promuscis."

I had almost omitted to call attention to the fine set of saws (two pairs) and their sheath, so well displayed. In considering these, however, it should be remembered that they have been displaced, the natural position being (for one side), as roughly shown in Diagram, Pl. XIV., Fig. 10.

Ophion luteus (Pl. XIV.).—This slide requires several hours to master the details of structure with which we are presented in it. I can only glance at them by a slight enumeration as follows: —Tongue, parts of the mouth, antennæ, wings with their hooks, comb-like claws, and ovipositor. The tongue may be advantageously compared with that of a wasp, and is strikingly different from that of bees. The antennæ show structure, described by Dr. J. Braxton Hicks, which he supposes to be, from their structure, an acoustic apparatus, and on very good analogical grounds, it seems to me. The paper will be found in a volume of "Linnæan Transactions" of a few years back, and marks a decided advance in the knowledge of the subject.

How very different, again, are the hooks on the wings from those of the great Humble-Bee, marking an insect of feeble flight! I have not unfrequently seen them in the autumn, or even in sunny days in the winter, hawking over the common here, in search of a suitable nidus for oviposition: this is the naked-skinned caterpillar. By means of the serrated claws, the frightened creature is held, notwithstanding all its writhings, till the egg is laid in its body: the eggs are described as being of a singular form, somewhat bean-shaped, as Fig. 11, and attached near one end to a long, slender, and curved peduncle, by which they are attached—unlike the majority of the eggs of this family—to the surface of the body of the larva of *Cerura venula* (the Puss Moth). When the eggs are hatched, the larva remains in this situation, the extremity of the abdomen being retained within the shell of the egg, as in Fig. 12, whereby they are enabled to suck the juices of their victim (Westwood, Mod. Intr., Vol. II., p. 145). I have never been fortunate enough to see this, but hope E. L. or some of our entomologists will tell us more about it. It appears there are five described species. The singular, somewhat curved mark on the eyes, shaped like a hollow club, differs from anything I remember to have noticed elsewhere, and it seems to me difficult to explain the meaning of it.

Pro-Leg of Larva of Puss-Moth.—A remarkably fine and interesting specimen, and derives additional value from its having been prepared and named by an entomologist. The notes accompanying it, too, are exactly the sort of thing I am so desirous our members should give when putting their specimens into the boxes. The contributor has exactly hit my idea of what is wanted in these notes—anything throwing light on the subject of the slides. We are just naturalists who make use of the microscope in our investigations. The graphic description of the Puss-Moth Caterpillar's tenacious clinging to whatever it may be upon is rendered clear enough on careful investigation of this slide.*

It may be interesting to call attention to the different modifications of hairs presented in the specimen for different purposes. There are, on the general surface of the skin, small, triangular, sharply-pointed "*scale-hairs.*" Then there are also about nine *spine-like hairs*, whose use may be considered to be chiefly for protection, short, strong, and stout. In addition to these, and above them, are a number long, flexible, translucent, whip-like, which agree in these characteristics with hairs whose recognised use is to inform the insect of the nature of the objects with which it comes into contact—"sensory hairs." And, lastly, it is not difficult to prove that the powerful claws themselves are but hairs,

* These notes will appear in our next part.—ED.

enlarged, greatly curved at their tips, strengthened with much chitinous material, as predicated by their deep colour—"claw, or clasping hairs." One of the most curious points shown in the specimen seems to myself to be the thin fold of skin, crenated at the edges in a number of indentations, corresponding to the claws, and which serves to cover them like a veil. It requires rather a high power and some care to see this; but of its existence there is no question, though it is not easy to conceive for what special purpose it can be required.

TUFFEN WEST.

EXPLANATION OF PLATE XIV.

Details of *Ophion luteum*.

Fig. 1.—Eye, showing dark, club-shaped mark.

,, 2.—Trophi :—*m.*, mandible; *mx.*, maxilla; *mxp.*, maxillary palpus; *lbr.*, labrum; *lb.*, labium; *lbp.*, labial palpus.

,, 3.—The wings of one side, showing areolation, position of the hooks, and of the thickened portion of fore-wing, on which they work.

,, 4.—*a*, *b*, the hooks shown in different positions, eight in number on one wing, nine on the other.

,, 5.—Abdomen, the segments numbered consecutively: *d.*, the dorsal; *v.*, ventral portions. Seven pairs of spiracles are seen, the barbed portions of the ovipositor, and their sheath.

,, 6.—Last joint of the tarsus from the intermediate leg of the right side. The fleshy organ borne on a pedicle between the strongly pectinated claws is a sucker, of a type specially characteristic of the HYMENOPTERA, as Bees, Wasps, Ants, Ichneumons, Saw-Flies, etc. Two long vibrissæ on each claw form a noticeable feature here.

,, 11.—Egg of *Ophion luteum* on long curved peduncle, by which it is attached to the body of the larva of the Puss-Moth.

,, 12.—The egg hatched, and still retaining the extremity of the body of the larva.

,, 7.—Seed of *Typha latifolia.*

,, 8.—Gizzard of Cockroach :—*a*, end of the crop; *b*, the gizzard, in profile; *c*, commencement of the œsophagus.

,, 9.—Gizzard of Cockroach, as seen from above.

,, 10.—Diagrammatic sketch of saws of *Cercopis sanguinolenta: a*, one of the inner pairs of large ovipositors; *b*, one of the outer pairs of saws, finely toothed; *c*, the sheath.

Selected Notes from the Society's Note-Books.

Naphthaline is a white, flaky-looking crystal, which accumulates in gas-pipes (to my great annoyance), gradually choking them up. It can be procured at the gas-works when some of the periodical cleaning takes place.

Dissolved in mineral naptha and crystallised on a slide by evaporation, it forms an interesting object. I find difficulty in mounting it. Castor-oil dissolves it instantly; glycerine does so slowly.

RICHARD SMITH.

Naphthaline is described in "Chambers's Encyclopædia" as being easily and abundantly produced from the last portion of the distillate of coal-tar," crystallising in large, thin, rhombic plates, having a pearly lustre.

R. H. MOORE.

Chalcedony.—I see little structural difference between Chalcedony and Siberian Agate, but am not surprised at this, as I learn from Tomlinson's "Arts and Manufactures" that the chemical composition of agate, chameleon, chalcedony, onyx, bloodstone, sard, moss-agate, and many others, is identical. In the slide before us, the discs are nearly perfect, and justify the old name, viz., "Fortification Agate." The Siberian agate is more wavy in appearance, and the centre is broken up, as it were, by gritty-looking particles, but is a more brilliant object under the polariscope.

H. E. FREEMAN.

We have certainly advanced since the days of Pignelius, who remarks on Chalcedony, in connection with Rev. xxi. 19, that the "stone hath the colour of a pallid lamp, shines in the open air, but is dark in a house, *cannot be cut* (!), and has powers of attraction." What would he have said to the section before us?

E. E. JARRETT.

The specimen before us is the most regular in its crystallisation I have ever seen. I think the variations in crystalline form found in many of these nearly pure forms of Silex are produced by the varying rate at which they have cooled, doubtless combined with other causes. It is certain, however, that the various modifications exhibited in them may be produced in many mineral salts by variations in the amount of heat used, and the rapidity or slowness of cooling, as I have personally found. It is to the prevention of natural crystallisation that so many of our pretty polariscopic slides owe their character. I know much may be said against the igneous origin of Chalcedony, and that I have taken for granted, both, that it is a modified crystalline form, and produced in part by heat; but I think what I have seen, (and doubtless other members who may have tried their hands on crystallising mineral salts have seen the same,) warrants the supposition that agate, in many of its forms, is the result of crystallisation, modified by variations of heat and other surrounding conditions.

D. MOORE.

Antennæ of Cockroach.—I have counted 74 or 75 joints in each antenna.

R. H. MOORE.

Tracheal System of Caterpillar.—Quekett's method of preparing these objects with acetic acid I have found very unsatisfactory. My slide was prepared thus:—Having cut off the head of the caterpillar, and made an incision down the back, I placed it in a solution of sub-carbonate of potash and lime (*Liq. Pot.* would do). In three or four days the body had become of a hard, cheesy consistency. It was then easy to turn it out of the skin with a blunt knife. Boiling in potash for a few hours dissolved the mass (which, by the bye, I had gently crushed), and the trachea was left floating in the liquid. After washing well, it was floated on to the slide.

THOS. LISLE.

Trachea of Caterpillar.—Mr. Lisle's process, as described above, is certainly the best and easiest. But I do not think that boiling is necessary, as I have procured good specimens by steeping only in *Liq. Pot.* (strong solution) for four or five days. After that take the insect out of the solution, place it in a shallow dish

of water, make an incision along the back of the insect (end to end), and then gently wash out the inside. By doing this, you not only get the tracheal system, but also the skin, which you can mount, whole or in parts. If you wish, you can stain the tracheæ with carmine or logwood, but I have not met with very good results.

C. C. Bose.

Feet of Blow-Fly.—I insert this slide, thinking it will probably incite members to look up the subject of **Feet of Insects.** It is quite clear, from the vast array of hairs on the feet of *Dioctria rufipes*, which is in the same box, that the creature cannot use them as "suckers," and if anyone will examine the feet of the common house-fly, I think they will be convinced that it does not walk on glass by any sort of atmospheric pressure. Such creatures can walk as easily in the exhausted glass of an air-pump as in a common tumbler. But put them, first, into a box containing any very fine powder—say, carbonate of magnesia—they will be unable to walk up any glass at all. Watch them, and they will be seen to wipe their feet in their own peculiar way. The insects know when the very sticky hairs on their feet are clogged with dust and cleanse them duly. But there are insects which have regular sucker-feet; of these I now say nothing. An observer will soon notice that the hairy part, which I will call the boss or brush, is sometimes of considerable size and length, and the creature—unless there were a special apparatus for the purpose—could no more put the pad down flat than we can hold out a newspaper level by holding it by one corner; it would fall thus ˥, instead of remaining thus ———. To effect the desired end, *i.e.*, of keeping the brush flat—there is a variety of contrivances, and into these our members will do well to pry. In the feet of *Dioctria* may be seen two rigid rods; in the Blow-Fly there is an elaborate appearance, consisting of strong ribs and a number of minute rods proceeding therefrom. To describe much more would be to deprive microscopists of a great pleasure. I will only say that the foot of the Wasp, Bee, and Hornet puzzled me for years. I never could make a satisfactory slide. A friend at last gave me one, in which the pad was unpacked.

Thos. Inman.

Feet of Insects.—The *Dioctria*, alluded to by Dr. Inman, is mounted in glycerine jelly, and it is this which causes the pulvelli to show so well. I believe that the pads of insects' feet are of glandular structure, and that they secrete a mucus (like that of

spiders' webs, etc.), which hardens on exposure to the air, and that when the fly wishes to detach its foot from the surface to which it may be adhering, as in the act of walking, it re-dissolves this hardened mucus by emitting a fresh portion from the glands. The hair-like bodies with which the pads are covered are probably hollow tubes—*i.e.*, ducts to convey the mucus.

F. J. ALLEN.

The Carlisle Microscopical Society.

Salmon Disease.

BY DR. LEDIARD.

THE ordinary monthly meeting of the Carlisle Microscopical Society was held on Friday night, January 4th, 1884, in the Young Men's Hall, Fisher Street, when Dr. Lediard, the Vice-President, read an interesting paper on "The Salmon Disease," of which the following is a report:—

The VICE-PRESIDENT said the salmon disease was especially worthy of their consideration. It had even claims upon any Microscopical Society, and more especially this Society, inasmuch as it was a disease which was present in the Eden, and had been so since 1878. As far as he was aware, no clear views on the causation and maintenance of the fungus had as yet been put forth; season after season passed and salmon was still a prey to its ravages. It was more than likely that the disease was known prior to 1821, but was not studied. Since then, many scientific men, both in this and other countries, had turned their attention to the mode of reproduction of the fungus, and in recent years a Royal Commission sat at Carlisle and many other towns in the district, and obtained much valuable information of all kinds likely to have any bearing upon the origin of the disease. To the report of this Commission he had gone for his information, and his gleanings from the Blue Book, as well as such specimens as he had been enabled to get, must form the bulk of his present paper. That the disease existed in North America, Mr. Byers had testified; moreover, it was a disease well-known to the Indians. This was

important as showing that even large and unpolluted rivers afforded but little immunity. Up to the present time the disease had shown itself to be remarkably local; for the Tweed, Nith, Annan, Doon, Esk, and Eden were marked from all other rivers in this country. In the south, the Severn and Wye, both famous salmon rivers, had been up to now quite free from any trace of the disease.

It seemed to be agreed that the salmon disease was due to a fungus which grew upon the cutaneous textures or skin of the fish; and not only upon salmon but upon many other kinds of less important fish, the fungus was also developed in aquaria. It resembled dirty cotton wool, and might be seen on all parts of the fish, the fins most especially seeming to afford a suitable soil for growth. Attacking the head, the fungus might extend so as to cause blindness, and it might extend about the gills so as to cause suffocation. It also extended into the mouth, and in some cases so as to lay the bones quite bare, and occasionally causing inflammation of the brain lying beneath. There was hardly any part of the body of the fish which was not liable to be attacked, but the parts first affected were the softer portions of the body which had no scales. The effect of the disease was clearly to cause pain and irritation. The fish knocked itself about, and skimmed along the surface of the water, possibly to rub off the fungus, or relieve the irritation. Death was brought about by suffocation and the destruction of the natural function of the skin.

He next described the fungus as seen under the microscope. On taking a portion of the fungus and allowing it to spread itself out in a drop of water, it would be seen that there were numerous threads spreading in all directions, interlacing and joining each other, and to appearance they were colourless. The base of the disease consisted of a network of similar threads, which extended like the roots of a plant. The growth was exceedingly rapid, and when the filaments were mature they bore fruit which consisted of zoospores, rounded bodies consisting of protoplasm endowed with movement, whose chief object seemed to be to escape from the tube which contained them. They might be seen working up and down a tube until they escaped one by one from an opening at the summit, and, when free, dashed away and formed tubes for themselves. In escaping from the mouth of the tube, these zoospores shaped themselves to the size of the opening and then regained their former rotundity. Dr. Cooke spoke of them as having a pair of threads, which are used as oars for propulsion. He had not seen these legs, but he had little doubt that they were analogous to the cilia which they were familiar with in the oyster and other lower forms of life found

in water. There was another kind of fruit which the fungus produced, viz., the resting spores, so called from the fact that they remain from one season to another, at the bottom of the water. The heads of the fungus were so slender that it was almost marvellous how any impression could be made upon the scales of the fish. It would seem, however, that any injured portion of the body was especially liable to be attacked, and fish received injuries through fighting, or at weirs, or by coming in contact with any obstruction.

We have in the human body a disease called diphtheria, and it was believed that diphtheria would readily attach itself to any wound on the body; and thus salmon disease was likened by some to diphtheria. There were other conditions which seemed to predispose to the disease besides injuries, such as debilitated condition of fish due to want of food or low water. Overstocking and an ill-aërated condition of the water had been connected with the fungus, more especially in aquaria; and what was more important than all, the fungus seemed to attack spent fish, or fish that had just spawned and were much out of condition. It was thought at one time that only unclean fish were attacked, but it was now recognised that spawned fish were simply more liable than others to be diseased.

Coming to the consideration of the cause of the disease, they were met with a sea of doubt, a wilderness of opinion; for, take any cause that had as yet been suggested, and it was quite possible to show that the disease was present in totally different circumstances. He showed that the disease existed in rivers polluted, and rivers unpolluted. Whilst pollution might not be a direct cause of the disease, there could be no question that anything which interfered with the purity of the water must indirectly interfere with the health of the fish; and, therefore, through sewage contamination or other impurity, salmon might become less able to resist the attack of the fungus; and this should induce authorities in towns on the higher waters of rivers, not to allow the sewage or other refuse to pass into the river; whilst for towns near the mouths of rivers, sewage should be, if allowed to go into the river, emptied as near the tideway as possible. In confirmation of this, it had been found that a good supply of clear water was a certain cure for fungus when it appeared in the tanks in aquaria.

No disease had been reported from Norway, where the rivers were frozen over until May; but, on the other hand, Mr. Byers had seen thousands of diseased salmon in the Harrison River, in British Columbia. Incidentally he stated the disease was a fresh water disease, salt water curing it. Much evidence going to show the possible influence of a low condition of the water upon salmon

disease was laid before the Commission; and upon the face of it, it seemed very likely that a scarcity of water meant a deficiency of food and overcrowding of fish in holes; and hence a liability to a feeble condition of the fish. The Eden was sometimes very low, but was liable to such periodical flooding and flushing as should do away with any thought that this cause could have any effect upon the salmon disease; there was indeed no loch which was constantly supplying the rivers with clear water, as was the case with many rivers in Scotland, such as the Tay and Forth; and it would appear the presence of these lochs must have a very beneficial effect upon the river, and thus tend to keep up the general health of the fish.

Breeders of salmon by artificial means had shown that overstocking was a most certain cause of fungus; inasmuch as the disease was prone to attack any bruise or wound on a salmon, it was quite clear that all causes which might produce injuries should be met; and all seemed to admit that fish had great obstructions to contend with at weirs. Thus many fish got blocked at Armathwaite Bay, fought in hundreds, and knocked themselves to pieces. The same thing existed on the Tyne, about Alston. It would seem that this cause was capable of easy remedy, and the same might be said of the presence of dead fish, upon whose bodies the fungus continued to grow, producing spores which might rest at the bottom of the water, and so perpetuate the disease.

The practice of removing dead and diseased fish at all seasons of the year was, no doubt, to be highly recommended as a means of stamping out the disease. Dr. Cooke quoted a writer who believed that if otters were preserved for a season or two many of the diseased and weakly fish would be got rid of and the breed of fish improved, inasmuch as the strongest and best fish no doubt escaped their natural enemy; but Dr. Cooke seemed to think that the general health of the fish must be so improved as to enable them to resist the attacks of parasites. In Canada, fish-breeding was carried on to a large extent with considerable benefit, and there were advocates for the introduction of this practice in this country as a remedy against the salmon disease. In conclusion, he spoke of the condition of the flesh of diseased salmon, the whole of which he thought was probably unwholesome. (Cheers.)

The President thanked Dr. Lediard for his paper.

Mr. R. Routledge remarked that the disease is found specially among clean fish. In all diseased fish the liver was much enlarged. As soon as they touched the sea-water the fungus was washed off, and the salt water parasite got on to the fish. They

could cure the disease in aquaria. He gave an instance of a fish being cured in an aquarium. The disease spread quickly; he had seen a clean fish go among diseased fish, and in two or three days it began to show the disease.

Mr. Brown said that the disease appears not only upon other kinds of fish, but also upon insects. One appearance Dr. Lediard had omitted to mention which was very common in this disease and that was hæmorrhage in the muscles; and he had no doubt that if this fish on the table were cut up they would find in its muscles large collections of blood.

After remarks by other Members, the meeting separated.

Reviews.

The Gentleman's Magazine for January contains a very interesting paper on the "Garden-Snail," from which we make the following extract:—

"The snail who has arrived at the adult condition must have done so, of course, by eating food; and the way he performs this necessary operation is really very curious and remarkable. Everybody who has seen a cabbage-leaf off which a snail has been making his simple and inexpensive breakfast must have noticed that its edges are quite cleanly and neatly cut, as if by a knife or a pair of scissors. That suggests to one at once the idea that the snail must be possessed of a sharp and effective cutting instrument. And so indeed he is, for he has a keen, horny, upper jaw, which closes upon a very remarkable saw-like organ below, commonly called the tongue or dental ribbon. This tongue is a long, muscular, and cartilaginous strip, like a piece of narrow tape, armed all over with an immense number of little teeth or curved hooks, for tearing and masticating the food. It is coiled up inside the mouth, and only a small portion of it is brought into use at any given time; as fast as the hooks on one part are worn out, another part is unrolled from behind, and made to take its place in front for the purpose of feeding. The little teeth, of which there are several thousands—the slug, for example, has 160 rows, with 180 teeth in each row—are formed of silica or flint, and cannot be dissolved, even in acid. They are coloured like amber under the microscope, and form most beautiful translucent

objects when properly prepared and mounted on a slide. This lingual ribbon acts in practical use exactly like a very hard and sharp file. It is with the rasping instrument that this limpet slowly bores its way into the solid limestone or granite rock, and that the whelk eats a hole through the nacreous material of the hardest periwinkle's or oyster's shell. The back of the tongue has its edges rolled together into a tube, and is the growing part of the organ, where the new teeth are from time to time developed; and as fast as the front rows get blunted or broken by use, the tube opens gradually forward, and brings the fresh, sharp teeth from behind into play to replace them. The shape and arrangement of the lingual hooks is very characteristic of the different groups of snails. One generic form prevails amongst the members of the genus Helix, another amongst the Papas, a third in the Clausilias, and a fourth in the true slugs. Doubtless, each variation in this respect has been definitely developed with reference to the peculiar food and habits of the different genera."

Vol. CCLVI., pp. 28–9.

THE METHODS OF MICROSCOPICAL RESEARCH;
POPULAR MICROSCOPICAL STUDIES;
STUDIES IN MICROSCOPICAL SCIENCE.
By Arthur C. Cole, F.R.M.S.

Since our last notice of the above valuable series, we have received the following:—

Part 5 of the "Methods" is a continuation of the "Preparation of Tissues," and treats of various methods of injecting tissues; Part 6 of Animal and Vegetable Section-Cutting, with the use of the Microtome; and Part 7 of Stains and Staining.

Of the "Popular Studies," No. 3 describes the Human Scalp, and contains a plate of a Vertical Section of Human Scalp, double stained; No. 4 describes the Ovary of Poppy, with a plate of double-stained transverse section of Ovary of *Papaver rhœas* (unfertilised); Nos. 5 and 6 describe a Grain of Wheat, with plates of, 1st, a longitudinal section of a Grain cut through the Embryo, 2nd, a plate explaining the Germination of the Grain, which is to be fully described in the next number. The subjects treated in the "Studies" since our last notice have been—"Epithelium,' "The Cell as an Individual," "Cartilage," "Morphology of a Tissue," "Areolar Tissue," and "Tendon," illustrated by plates showing Epithelium (three kinds); *Micrasterias denticulata*,

trans. sec. Hyaline Cartilage, Areolar Tissue, Types of Simple Tissues, Prothallus of Fern, and Tendon of Lamb.

THE MEDICAL ANNUAL and Practitioners' Index, 1883–4. (*Henry Kimpton, London.*)

This handy little volume is intended to be a YEAR-BOOK for the study-table of the medical practitioner. For easy reference the book is arranged in sections—*e.g.*, The Year's Work, Journals, Inventions, Health-Resorts, etc. etc., and under the various divisions the articles are arranged alphabetically.

BOLTON'S PORTFOLIO OF DRAWINGS. No. 10.

This Portfolio contains drawings of two representatives of the vegetable kingdom, and seventeen of the animal kingdom. Of the latter, we are informed that *Chilomonas spiralis* and *Asplanchna Ebbesbornii* are new to science. For a fuller description of this latter, we would refer our readers to an article in the October part of "The Journal of the Royal Microscopical Society," 1883.

POPULAR ACCOUNT OF THE FISH'S NEST, Built by the Stickleback (*Gasterosteus trachurus*). By Silvanus Wilkins and T. Bolton. (*Birmingham: Thos. Bolton.*)

This very interesting little pamphlet consists of—1st, a paper by Mr. S. Wilkins read before the Birmingham Natural History and Microscopical Society, and followed by "Notes in reference to Sticklebacks' Nests," by Thos. Bolton, F.R.M.S.; and "On the Structure and Habits of the Stickleback," and "The Anatomy of the Stickleback," by John Ernest Ady. It is illustrated with four plates, and will be read with much pleasure by all naturalists.

THE AMERICAN NATURALIST. (*McCalla and Staveley, Philadelphia.*)

The January and February parts of this very capital Journal have reached us; their contents are well selected and interesting. Some of the articles are, more than others, especially to our taste; of these, we would name, "Observations on the Pulsating Organs in the Legs of certain Hemiptera," with plate; and "Notes on some Apparently Undescribed Infusoria from Putrid Waters," illustrated. But we read the whole of each journal with much pleasure.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL, edited by Mr. Romyn Hitchcock, is, as usual, full of entertaining and instructive matter. In the February part, just to hand, is commenced the first of a series of Papers on "Microscopical Tecnic." The first article treats of Apparatus and Material. The limited space at our disposal forbids a more lengthy remark on the present occasion.

Current Notes and Memoranda.

The President of the CARLISLE MICROSCOPICAL SOCIETY has asked us to publish the following very interesting Letter from Dr. W. B. Carpenter, F.R.S., who has recently become an Honorary Vice-President of that Society:—

"London; Nov. 28th, 1883.

DEAR MR. C. S. HALL,—

I accept with much pleasure the office of Vice-President of the Carlisle Microscopical Society, for which you are good enough to propose me; and shall be very glad if any words of mine can help to give such a direction to the work of its Members, as may prevent the 'power' of your Society from 'running to waste.'

For this end it is extremely important, in my judgment, that Microscopists should first train themselves in the expert use of the instrument and its most important appliances; and should then devote themselves *especially* (I by no means desire *exclusively*) to *some particular study;* each selecting what his own opportunities and mental interests make him feel most suitable to himself.

It was thus that my late friend and early pupil, G. H. K. Thwaites, who had taken up the study of *living* Diatoms at my suggestion—now forty years ago—was enabled to discover the cardinal fact of their conjugation and production of a Zygospore. And if one tenth of the time that has been since bestowed on the markings of their valves had been given to the study of their life-history, our scientific knowledge of the group would have been greatly advanced, instead of remaining almost stationary. The continuous study of the life-history of the *Monads* by Messrs. Dallinger and Drysdale, which has given results

of first-rate importance to Biological Science, is a recent example of what may be done by a combination of two (or more) qualified observers. And I need scarcely point out to a body including many Medical men, what a wide field there now is in the study of *disease-germs*.

As a qualification for that study, I should suggest the determination of the life-history of the *Yeast-plant*. For there is a strong reason to believe that what we know under this form is only an aberrant stage in the life of an ordinary *Mucor;* its cell-germs developing themselves in a very different mode, in a sacchara-albuminous liquid, from that in which they vegetate on an ordinary mould-producing surface. And while, on the one hand, it was long since observed by Mr. Berkeley that a *Mucor* may develop itself in a *confervoid* form in ordinary water, it is still an open question whether, if growing in an organic fluid, the same Mucor may not become the 'Vinegar Plant.'

I have always, myself, been a believer in the great polymorphism of the 'saprophytic' Fungi; and I recently read at Southport, a paper on 'Disease-Germs from the Natural History point of view,' in which I argued that the extension of the same idea to disease-germs will account for many clinical facts observed by able practitioners of Medicine, which have hitherto received (in my opinion) far too little attention,—I mean, the occurrence of what have been called hybrid varieties of *Exanthemata*, or of forms of fever intermediate between Typhus and Typhoid, or the conversion of an endemic malarious remittent into a contagious fever.

It is because the Microscope thus gives most important aid in the working out of some of the fundamental questions of Pathology, that I am most anxious to see Medical men training themselves to the right use of it.

Believe me, yours faithfully,

WM. B. CARPENTER.

C. S. Hall, Esq."

We are informed by Mr. Chas. Collins, 25, St. Mary's Road, Harlesden, N.W. (nephew of the well-known Mr. Chas. Collins, of Portland Road), that he has lately given considerable attention to the study of the Scales of Fishes, and that he has now prepared for sale a selection of over 50 varieties. Of these we have seen—Scale of Boar-Fish, mounted for the Polariscope; Scale of Sole, and Skin of Dog-Fish, both mounted opaque. The style of mounting leaves nothing to be desired.

We have been favoured by the Secretary of the NEW YORK MICROSCOPICAL SOCIETY with an invitation to the Sixth Annual Reception of that Society, which was held on Friday evening, Feb. 1st, 1884.

From the programme enclosed, we should judge the entertainment to have been of an unusually interesting character. The subject of the address, which was given by B. Braman, Esq., the retiring President, was "The Microscope in Art." The exhibits, of which 48 are described in the programme, are well selected. We are particularly pleased to notice that each exhibit is more or less particularly described in the programme, thus affording a more lasting interest and instruction to the visitors. We have only space to quote one or two, viz. :—

"3.—TONGUE OF HUMBLE-BEE.—With its *lingula*, or tongue, the Bee collects nectar from flowers by lapping, not by suction.

"9.—POLYCISTINA are a family of the low order of animal life, called Rhizopods. Their foraminated, siliceous shells are found in great abundance in a tertiary deposit 1,100 feet thick in the island of Barbadoes. In the living state, thread-like organs (*pseudopodia*) radiate from the interior through openings called *foramina*.

"11.—CILIA OF THE OYSTER. Cilia are transparent, thread-like organs, which have an important connection with the vital functions. Their motions in the oyster serve to drive a current of water over the surface of the gills, so as to aerate the blood; also, to direct a part of this current to the mouth, to supply food."

We would recommend this style of programme to secretaries and others connected with our local microscopical societies.

Bacilli.—Those of our readers, medical or otherwise, who are studying this organism will, perhaps, be interested in the following extracts from "THE LONDON MEDICAL RECORD" for Feb., 1884.

Prof. Sormani says, in the *Annali Universali*, Sept., 1883:— "For microscopic examination of the Bacilli.—A thin layer of sputum, spread on a cover-glass, is dried over the flame of a spirit-lamp, and then immersed in the solution of gentian-violet (Weigert's formula:—Gentian-violet, 1·5 parts, dissolved in 15 parts of absolute alcohol; add 3 parts of oil of aniline, and dissolve in 100 parts of distilled water). It should remain in this solution for 15 or 20 minutes, or longer; it is then rapidly passed into dilute nitric acid (50 per 100), then into alcohol, and then into a weak aqueous solution of vesuvine, and, lastly, well washed in absolute alcohol. The preparations may be mounted in oil of cloves, castor-oil, or dammar varnish. Sections require three or four

hours to take the colour, and should generally be allowed to remain twenty-four hours."—P. 52.

Burrill on Staining Bacilli.—Dr. S. J. Burrill (*New York Medical Record*) recommends the following method of staining Bacilli:—Take glycerine, 20 parts; fuchsia, 3 parts; aniline oil, 2 parts; carbolic acid, 2 parts. Make a solution, and keep for use. When required, put about two drops in a watch-glass (a small pomatum-pot is better), full of water, and gently shake or stir. Put in the smeared cover-glass, after passing it a few times through a flame, and leave it at the ordinary temperature of a comfortable room for half-an-hour. If quicker results be desired, boil a little water in a test-tube, add double the above quantity of staining solution, shake it gently till dissolved, then pour into a convenient dish, and put in the cover-glass. Staining will be effected in about two minutes. The preparation is decolorised in the usual way by nitric-acid solution, one in four, in which it is left about a minute, then dried, and mounted in Canada Balsam.

London Medical Record, Feb., 1884, p. 73.

We are requested to insert the following queries, and shall be glad of replies:—

What is the effect of acetic acid upon chitine?—E.T.S.

If acetic acid be used in the preparation of specimens for mounting, where is it to be placed in the formula for mounting?—E.T.S.

Would some members of the P.M.S., or reader of this Journal, give their ideas upon Development, Introduction of New Species or Genera, and Alteration or Change in established Species?

Development necessarily implies improvement in some particular; and this, though there may be at the same time a degeneration; thus, it is correct to say that there is a development in some muscles of the Quadrumana as compared with the corresponding muscles in man, though the species is of an inferior type. I do not know if there is any well-authenticated instance of the introduction of a new genus, while there are many instances of the gradual formation of a new species: but I should like very much to know if there has been any introduction of a new species, which has not really been arrived at by alteration or modification in an old-established species, when subjected to altered conditions of existence.—Enquirer.

Answers to the above queries, if found suitable, will be inserted in our next.

THE JOURNAL OF MICROSCOPY
AND
NATURAL SCIENCE:
THE JOURNAL OF
THE POSTAL MICROSCOPICAL SOCIETY.

JULY, 1884.

On some New Infusoria from Bristol.

By J. G. Grenfell, F.G.S.

Read before the Microscopical Society of Bristol, 1883.

Plate 15.

LAST winter I obtained some new infusoria from a little ditch near Bristol. The first of these is a new species of *Zoothamnium*, which I have named *Zoothamnium Kentii*, after Mr. Savile Kent. It belongs apparently to the homomorphic division of the genus, in which there are no large reproductive zooids; at least during the months of January and February I did not see any of these on full-grown colonies. Unfortunately the drought of March dried up the ditch, and I have not been able to obtain any since then.

Z. Kentii (Pl. 15, Figs. 1 and 2) is an exceedingly fine species; I have counted as many as 80 or 90 zooids in a single colony. The length of this colony was 1-11th inch. The zooids are conical-campanulate, and considerably elongated, the length being

nearly twice the breadth. The peristome is thickened, but not very prominent; the endoplast is large, band-like, and curved. When contracted, the zooids are nearly spherical. They are grouped on a main rachis, which subdivides dichotomously with great regularity. After the last main subdivision of the stems there are generally two short stalks on the same side, and the terminal one, each ending in a pair of almost sessile zooids. The stems are broad and very finely ribbed transversely. These, and all the zooids, are covered more or less thickly with a characteristic flocculent coating, which was of a brown colour in this ditch. The number of zooids in a colony varies from 3 or 4 to 80 or 90. The larger colonies are very active and timid, frequently contracting so as to form a ball at the top of the main rachis, and sometimes remaining thus for 24 hours. The small colonies remain extended for long periods. The zooids very readily leave their stems. Length of zooids, 1-285th inch. Habitat, grasses and roots of plants in slowly-running water. This species most nearly resembles *Z. dichotomum*, but it differs from this and from all other species of the genus in the characteristic covering of flocculent matter. The elongated shape of the zooids is also characteristic. Contrary to the ordinary habits of the genus, I noticed in the large colony mentioned above that one very long branch often remained extended while the rest contracted, and this branch came up into position last after contraction. I also saw one of the lower branches contract independently, though the central fibrilla of the stem is continuous throughout the colony.

On Duckweed and other plants in the same ditch, I found a new species of *Pyxicola*, which I propose to call *Pyxicola annulata* (Pl. 15, Fig. 3). Lorica urceolate, nearly twice as long as broad, constricted on one side below the oblique anterior margin; the side walls more or less undulated or ringed. These undulations generally show two or three well-marked narrow ridges, the lowest of which is about half way down the lorica, and the two others are close above it. These are often much more clearly seen on one side than on the other, and occasionally they are difficult to see at all, or vanish altogether. The lower half of the lorica has no ridges. In these respects this species resembles *P. socialis*. The operculum is oval, and is surrounded

by a thickened border; under slight pressure the animal casts off the operculum. The pedicle is colourless, transparent, and short, about 1-5th the length of the lorica. As in *P. Carteri*, it is surmounted by a little boss-like prominence. Colour of the lorica, chestnut brown; yellow when young. The animal is thick, fusiform, at times nearly cylindrical. It generally protrudes very slightly from the anterior margin, its favourite position being with the edge of the operculum resting obliquely on the margin of the lorica, and the peristome completing the triangle. I have, however, seen it extended further, carrying the operculum some distance above the lorica, and in a vertical position. The contractile vesicle is large; sometimes two or three are formed, which may or may not coalesce before contracting. Length of lorica, 1-400th inch; breadth, 1-800th inch.

In many respects this species is very like *P. Carteri;* the points of difference are three.

First, the dimensions are quite different, and the difference is constant, as I have seen many specimens. The lorica of *Carteri* is three times as long as it is broad, while this is not quite twice. Secondly, the undulations of this species are much smaller than those of *Carteri*, taking more the form of rings. Thirdly, the rings are confined to the upper half of the lorica, while *Carteri* is evenly undulated to the foot. The undulating outline distinguishes it from *Affinis* and *Pusilla.* The animal is hardy; it lived comfortably for two months in a little corked tube, about an inch long.

On the same weed I found a number of new species of *Platycola*, which I have named *P. bicolor*, from the two colours of the lorica. (Pl. 15, Figs. 4, 5, 6, and 7). Lorica, dark yellow, oval, much depressed; length about 1½ times the breadth; the yellow portion of the lorica is obliquely truncated in front; from it a delicate, colourless neck rises to a height of about ⅓ the whole length of the lorica, measured from the basal surface of attachment of the lorica. The sides of the neck are straight, or very slightly concave; the upper side often nearly at right angles to the axis of the body. This colourless neck is the first point of interest in this species. De Fromentel describes a vaginicola, of which the upper two-thirds are colourless and transparent, the lower third brown. Mr. Kent thinks this so remarkable that he

suggests that the upper portion may be repaired, or even the newly-formed lorica of a young individual built up on the fragmentary basal portion of a deserted test. I have seen many specimens of this *Platycola*, and they all have the same peculiarity. The length of the lorica is 1-300th inch. The surface of a lorica, seen from above, and presumed to be this species, presented a number of fine transverse striæ.

The animal is very large; and if all the specimens I have seen are of the same species, it can protrude itself to an extraordinary extent, the height considerably exceeding the length of the lorica. This, however, was in a single small specimen (Fig. 7), which presented the further peculiarity that the colourless neck was quite two-thirds of the length of the lorica. It is possible this may be another species. As a rule, *Bicolor* is not protruded nearly so far; the total height being about two-thirds the length. At times the body is suddenly and very much constricted just at the margin of the collar, so as to present somewhat the form of an hour-glass (Fig. 4).

The peristome is unusually thick and prominent, and the ciliary disc is much elevated. By far the most interesting point, however, about the animal is the presence of a very delicate membranous hood, which has a large oval opening, is retractile, and projects backwards from the top of the ciliary disc, covering the oval opening. I do not know of any similar structure amongst the Infusoria. De Fromentel, in describing another species of this genus, *P. gracilis*, mentions that the vestibular bristle, in addition to being conspicuous, is often reflexed in a ring-like form, and so figures it. I quote this from Mr. Kent's Manual, where the figure is not reproduced. It is probable that *Gracilis* has a hood like *Bicolor*. Mr. Kent remarks that from De Fromentel's description and illustration it would appear that *Gracilis* has a distinct membranous lip or collar, such as occurs in the genera *Opercularia* and *Lagenophrys*. These collars, however, bear no sort of resemblance to the hood of *Bicolor*. I am not quite clear as to the function of this hood. I think I once saw the digested food issuing from this hood, and it is possible its use may be to keep the digested food away from the action of the cilia, and so prevent it from being again brought in by the current.

The pharynx of *Bicolor* is very large, and terminates in a tubular œsophagus, which extends down to the coloured part of the lorica.

The animal is quite colourless; inside the lorica a constant cyclosis of large granules may often be seen. I have seen no traces of a fringe round the lorica. In one case the lorica, when first seen, contained a second zooid, contracted, and not reaching to the neck; this one soon emerged from the opening and swam away. Amongst specimens of this species, I came across one which may possibly be a different species (Figs. 8 and 9). The lorica was yellow, oval, and rather more than 1½ times as long as broad. The anterior margin of the lorica was at right angles to the surface of attachment, or nearly so; its upper margin forming an everted rim. Seen from above, the opening was large, oblong, and oblique, the right side not raised at all, the left side produced so as to form a kind of ear. This peculiarity separates it from all other species of the genus. There was no frill-like expansion round the lorica. Two zooids inhabited the lorica; they were hyaline, the body thick, and protruding for some distance outward and forward. The peristome thick, and the ciliary disc a good deal elevated. I did not notice any hood, but my attention had not then been drawn to its existence in *Bicolor*. The animals extended themselves readily, but were also fond of remaining with their heads just filling the mouth of the lorica. Length of lorica, 1-333rd inch. If it is really a new species, I should propose to call it *Platycola aurita*. Its nearest ally seems to be *P. regularis* (De Fromentel).

P.S.—Since the above description of *Pyxicola annulata* was written, I find that Dr. Leidy discovered the same animal apparently on the other side of the Atlantic, just about the same time, and gave it the same name. This is a curious coincidence.

EXPLANATION OF PLATE XV.

Fig. 1.—*Zoothamnium Kentii.*

,, 2.—The same, a single zooid; *e.*, endoplast; *c.v.*, contractile vesicle.

Fig. 3.—*Pyxicola annulata*: *o.*, operculum; *c.v.*, contractile vesicle.
,, 4.—*Platycola bicolor*, showing *h.*, hood; *œ.*, œsophagus; *c.*, collar.
,, 5.—The ordinary shape of the lorica of *P. bicolor*, showing colourless collar.
,, 6.—*P. bicolor* enlarged, the letters as before.
,, 7.—An abnormally elongated specimen of *P. bicolor* (?).
,, 8.—*Platycola aurita.*
,, 9.—Lorica of *P. aurita* viewed from above.

On the Collection and Preparation of the Diatomaceæ.

By ALFRED W. GRIFFIN.

PART I.—Collection.

I CANNOT claim for this paper any originality of thought, neither can I introduce anything particularly novel; it is simply an attempt to gather together some of the ideas of the best authorities on the question, for the benefit of those whose want of leisure precludes them from searching out these facts for themselves. The study of the life-history of the Diatomaceæ is in itself a stupendous work, and the interest excited by it is increasingly great. But far more interesting is the study of their siliceous framework, which alike resists time and decay. The softer part of the frustule is requisitioned by Nature, and utilised by her in her many and varied operations, in obedience to that law which compels organic matter to undergo constant changes, whether progressive or retrogade in its work of utility.

The animated matter quickly loses its identity and its relation to form, but the silicified skeletons of *Triceratium* and *Coscinodiscus* are as perfectly preserved in the mud of the Thames as in the various fossil deposits of California, or those found in the guano of South America. There is scarcely a species of Diatomaceæ that occurs in this quasi-fossil condition which has not its living representative.

The Ægina clay marl, which is without doubt the oldest

formation in which the Diatomaceæ appear, has its forms, one and all, extant on our coasts, and I think I am quite correct in stating that every known Diatom, with the exception of one or two doubtful cases, is proved to be still occupying a place on some part of the earth's surface.

As the fossil deposits are, I think, the most extensive and beautiful in their variety of forms, and are also easily obtainable, they shall receive our first attention.

Under this head, let us consider the enormous sub-plutonic strata found on the Pacific coast of North America, and described by Professor Meade Edwards, and from which we learn that the fossil deposits may contain both fresh-water and marine species, though never of course in a mixed condition. Marine deposits decidedly predominate, and extend over a very considerable portion of the earth's surface, while fresh-water deposits, though of greater depth, are more decidedly local in their distribution. The Miocene-tertiary age furnishes us with the most important examples, and concerning these a correspondent in Virginia, U.S.A., thus writes me:—"There is a very long chain of Diatomaceous deposits within a few miles of the Atlantic coast, extending from Richmond Va. and Petersburg through Maryland into Pennsylvania; then follows a chain of fresh-water deposits beginning at Drakeville, New Jersey, extending to Montecello, New York; then through Connecticut, Rhode Island, Maine, Massachusetts, New Hampshire, and Vermont, into Canada and Nova Scotia. In the first two of these, *Eunotia* in many species abounds, in the others, varieties of *Navicula*, as *N. firma*, *N. rhomboides*, *N. tumescens*, and *N. serians*, but a certain similarity runs through them all, though the gradual appearance and disappearance of certain forms, from ten to twenty miles apart, is very interesting."

The appearance of the deposit is subject to the following variations, according to Professor Edwards, from a pure white through the various shades of grey, cream, and fawn, to an iron-rust tint. The texture is frequently friable, not unlike clay in its appearance when wet; at other times it is hard and stony, though always porous, and, when soft, of very little weight. As this deposit furnishes us with some of the most lovely known forms,

I would strongly recommend that specimens should be procured from various localities, more particularly from the following :–Petersburg, Richmond, Shochoe, Poplin, and Churchill, in Virginia; and from Maryland, Lower Marlborough, New and Old Nottingham, Piscataway, and Rappahannock Cliff. The most prominent forms in this last deposit are—*Asterolampra*, *Actinoptychus*, *Aulacodiscus*, *Actinocyclus*, *Amphitetras*, *Cosinodiscus*, *Cerataulus*, *Dictyocha*, *Eupodiscus*, *Grammatophora*, *Heliopelta*, *Omphalopelta*, and *Melosira*, but besides these there are many others, too numerous to mention. In passing, however, I would state for the benefit of those who are anxious to obtain the finest and greatest number of specimens of *Heliopelta*, that the deposit at Old Nottingham will prove better than any other. For the fresh-water series I would recommend Essex County, Connecticut River; Cherryfield, Maine; Port Hope, Canada; and Carson City, Nevada. This latter is a deposit which I have just received direct, and is, I believe, but little known; it is very abundant and pure; the predominating forms are fine examples of *Denticula lauta*, *Epithemia ocellata*, and *Surirella spiralis*. In the former stratum *Cocconema*, *Eunotia*, *Epithemia*, *Navicula*, *Nitzschia*, *Pinnularia*, *Stauroneis*, and *Synedra* abound in many forms and varieties.

A stratum similar to the Virginia and Maryland series, but of harder texture, has been found on the Pacific coasts of North and South America, and extending at least from San Francisco to the lower border of California, and, according to Professor Edwards, possibly further in both directions. In the bituminous shales of this series we come to that interesting deposit known as "Monterey Stone," which is well worthy of collection at the points of San Diego and Santa Cruz, because of the fine varieties of *Asterolampra* which it contains. Monterey stone is usually of a fawn colour, and is distinctly stratified. Large fossil shells and the bitumen of California are found in it.

At Badjik, near Varna, in Bulgaria, is a stony stratum, having shells and bones mixed with it; but the Diatomaceæ obtained from it are doubtless identical with those contained in our present brackish waters. Speaking from memory, I believe they consist chiefly of some fine examples of *Eupodiscus*, but the true deposit

is difficult to obtain. On the island of Jutland, in Denmark, is found a series of polishing slates, the *polischeifer* of the German geologists, containing *Trinacria regina*, which is quite local in its origin, and also *Coscinodiscus oculis-iridis*, both very abundant in the Für Rock; and it is also remarkable that the latter approaches in character, somewhat, the diatoms of the London clay. These were discovered some little time since by W. H. Shrubsole, Esq., F.G.S. The silica of the frustules has been replaced by iron pyrites, thus giving them, by reflected light, the appearance of brass buttons. I strongly recommend that these should find a place in every cabinet, and as Mr. Shrubsole informs me his supply is exhausted, he has advised me to apply to Mr. A. C. Cole, of London, with whose "Studies" we are all so well acquainted.

Another well-known deposit is that of Oran, in Algeria, which abounds in some of the smaller forms of *Coscinodiscus*, as well as *Dictyocha fibula*. Ægina and Caltanisetta, in Greece, furnish us with similar forms, intermixed with Polycystina and Foraminifera, evidently of the cretaceous age. The Springfield deposit also is justly celebrated for the variety and beauty of its Polycystina; and these are accompanied by forms of Diatomaceæ which are by no means less interesting.

Indeed, I might add that as there are so many localities which furnish these, it is very probable that the whole of the island of Barbadoes is occupied by one deep stratum of chalk marl. A similar deposit has been discovered in the Island of Trinidad, which is considered to be connected with the New Red Sandstone series. At Moron, in Spain, the same stratum again occurs; and a still further deposit was discovered by Dr. C. F. Winslow at a point about seventy miles south of the town of Payta, in Peru, on a broad plain, having various depressions, the bottom of which would correspond with the ordinary sea level. The surface of the soil is covered with salt to the depth of about fifteen feet; recent sea-shells are next met with, then the bones of certain cetaceans mixed with pebbles; then for one or two feet follows a yellow loam; and last of all the stratum containing the diatomaceæ, which consists of a thickness of from two to four feet. A similar deposit also occurs at Tetani, in Japan, and is certainly one of our most interesting series, from its comparative rarity and

the beauty of the siliceous shields it contains—*Asteromphalus Brookei* being especially deserving of notice.

At Five Mile Cañon, near Virginia City, Nevada, Dr. Meade Edwards states that there is an enormously thick stratum of Diatomaceæ, which is ground in extensive mills, and sold in considerable quantities as " Electro-silicon polishing powder."

Ehrenberg, speaking of the vastness of some of these deposits, draws our attention to one occurring on the banks of the Columbia River, in North America:—" The Columbia, in its course at Place da Camp, runs between two precipices composed of porcelain clay, 500 feet thick, covered with a layer of basalt, on which some volcanic stratum rests. The clay strata are of very fine grain, and some are as white as chalk. Dr. Bailey has shown that this apparently argillaceous layer is composed entirely of fresh-water diatoms. Its perfect purity from sand proves that it is not a drift. By its immense thickness of 500 feet, this layer of biolithic tripoli far surpasses any similar layers elsewhere, which attain ordinarily only one or two feet in thickness, although those of Luneberg and Bilin have a depth of forty feet; some beds we also know elsewhere having seventy feet; such are not pure, but are intersected by layers of tufa, or other material."

In turning nearer home we have some very pure fresh-water diatomaceous deposits—that of Mull, in Scotland, being when dry very soft and pulverulent; Premnay Peak, Glenshira sand, Lochs Canmor and Kennard are, perhaps, the best of the series.

In Wales, the ancient site of a mountain lake at Dogelly, and Cwm Bycham furnish us with supplies of much the same character as the foregoing. In Ireland, we have the well-known Mourne Mountains, Bellahill, Stony Ford, Upper Bann, Carrickfergus, and Toome Bridge. These deposits are all well worthy of notice. The prevailing forms here are *Campylodiscus Hibernica*, *Surirella nobilis*, *Cymatopleura Hibernica*, *Cocconema fusiforma*, *Pinnularia viridis*, *Gomphonema constricta*, and one or two forms of *Melosira*.

The borings made by the late Mr. Okeden, at Neyland, a creek near Milford Haven, Pembrokeshire, at a depth of thirty or forty feet, revealed diatomaceous earths, very rich, in the remains both of fresh-water and marine species; but I do not know of an

instance where a distinctly marine fossil deposit has been found in England.

For the collection of living species, Mr. Norman, of Hull, has supplied us with the following hints:—The most interesting forms occur in salt water, especially in shallow lagoons, salt-water marshes, estuaries of rivers, and pools left by the tide. Their presence in any abundance is shown by the colours they impart to the marine plants to which they are attached; or when found on mud, by the yellowish-brown film they form on the surface, and which if removed with a spoon will be found to be a very pure deposit. Such collections are best put at once in bottles, with a few drops of Carbolic acid; or they may be partially dried between pieces of tinfoil. Capital gatherings are also obtainable by carefully scraping the brownish coloured layers from mooring posts, or the piles of wharves and jetties.

Marine gatherings contain by far the most beautiful varieties of the diatomaceæ; our own coasts furnish us with some extremely interesting forms, particularly Lamlash Bay, on the coast of lonely Arran, Dunvegan, and various parts of the Island of Skye. But for immense diversification of species the American marine gatherings far outstrip us in richness, colour, and rarity. That of Pensacola, in the Gulf of Mexico, contains amongst other rather rare forms, *Auliscus pruinosus*, *A. cœlatus*, *A. radiatus*, *A. Hardmannicanus*, *and A. Stockhardti*. The *Campylodisci* are *C. echeneis*, *C. imperialis*, *C. cerebrecostatus*, var. *speciosa*, and *C. imperialis*. I must not omit a reference to another gathering, viz., Mobile Bay, Alabama. One slide of this has been proved to contain 196 varieties; and out of that number seventy-two were different species of *Navicula*. Mr. Mc.Neill, of Mobile, has recently discovered in this deposit a most interesting new diatom, which it is proposed to call *Triphyllopelta Mobiliensis*, from its presenting when dry the peculiar appearance of the form of a tri-lobed clover leaf on the disc, caused by three inflations. There are no rays, and the markings consist, according to my correspondent, Dr. Engel, of Virginia, in coarse radiating granules resembling faintly *Actinocylus subtilis*; being both radiating and concentric.

Mr. Ralf gives us some very useful hints as to the collection of marine species and their habitats, which are as follows:—On

Algæ *Cocconeis*, *Acnanthes*, *Striatella*, *Tabellaria*, *Grammatophora*, *Isthmia*, *Podosphænia*, and *Rhipidophora*. In salt marshes we shall obtain *Amphipleura* and *Melosira*, whilst in shady situations *Campylodiscus* and *Coscinodiscus* abound. The sides of ditches in marshes are often covered with various species of *Surirella*, *Navicula*, *Pleurosigma*, *Amphiprora*, and *Amphora*.

Some few Diatomaceæ are peculiarly autumnal, as *Hæmocladia Martiana*, *Berkleya fragilis*, *Dickeia pinnata*, and *Striatella unipunctata*.

In clear running fresh-water ditches, the plants and stones often have long streams of yellowish-brown slimy matter adhering to them, generally composed almost entirely of filamentous species, as *Schizonema* and *Micromega*.

The layers of Diatomaceous fronds on the surface of mud, are, according to Pritchard, often covered with bead-like bubbles of oxygen, which from time to time rise to the surface of the water, and carry up with them some of the deposit in the form of a scum, and which may be readily skimmed off the surface of the pond with an ordinary iron spoon, nearly, if not quite, free from mud and other impurities.

Good and rare specimens may be obtained from the stomachs of Holothuridians, Ascidians, and Molluscs, which inhabit deep water, and are often thrown ashore after a gale. All that is required is to dry them thoroughly, and afterwards submit the contents of the stomach to dissection.

To those collectors who are resident inland, I would suggest that the liquid in the tinned oysters sold by Messrs. Lazenby and Son, should be allowed to settle, and the deposit cleaned. The results will give some beautiful spheres of *Coscinodiscus* and other equally interesting forms.

The washing of oyster shells also furnish us with *Rhabdonema*, *Melosira*, *Endictya*, and many well-known marine forms. The fact of the Diatomaceæ rendering themselves apparent to the unaided vision by their great accumulation, and the discolouration of the water they inhabit is illustrated by *Melosira ochraceæ*, which occurs in most chalybeate waters; also by *Gomphonema geminatum*, which forms a brown deposit on rocks in summer; the same may be said of *Synedra ulna Schizonema* in swift-running streams.

Mr. Norman has furnished us with the following interesting particulars concerning the growth of *Campylodiscus costatus.* He says :—In the early part of the spring of 1856 I made a gathering of Diatoms from the Spring ditch, Hull. Although I met with a few frustules of the species named, I did not think it of sufficient interest to boil in acid for mounting; and the phial containing them was left in the window of my laboratory during the ensuing summer. Some time in the autumn I had occasion to make use of this bottle, when I noticed the surface of the deposit, and the sides of the bottle covered with a dense brown growth of diatoms. On further examination I found an immense colony of *Campylodiscus,* which gave by preparation some beautifully pure slides. When removing the upper layer, I purposely left a few of the frustules in the bottle, which was placed in the window as before. These have again increased to a great extent, and now they appear to thrive in perfect health.

Remarkably pure gatherings may be obtained also by Reinicke's method, the principle underlying which is based on the extraordinary property possessed by the Diatomaceæ of pressing towards the light. A quantity of mud on which the fronds of these little organisms are growing is spread on a common dinner-plate, and upon this is laid a piece of thin muslin, and a little water poured upon the whole, that it may be entirely covered. The plate is now placed in the window of a room where the rays of light fall full upon it, and in the course of a few days the tiny frustules of the Diatoms will begin to creep through the muslin and form a thick growth entirely free from earthy matter.

This plan can, however, only be carried on with certain species whose movements are free and active, as *Pleurosigma*, *Nitzchia*, *Cocconema,* and *Navicula.* Gerstenberger's plan is so much after this character that it will be needless to repeat it. Successive crops of Diatomaceæ may be taken at short intervals, provided the conditions of nature are complied with, by the creation of an artificial spring and winter, which is simply done by allowing the mud on which they are growing to become nearly dry, then pouring fresh water over it, and once more it will be covered with new and luxuriant microscopic life. By some such methods as these applied

to those of Reinicke's and Gerstenberger's, a poor gathering may ultimately become a very rich one.

Another mode of collection is by skimming the surface of the sea with a very fine muslin or calico net, having a wide-mouthed bottle tied to an opening in the end, and towed at the stern of a boat. By this means that species of *Rhizosolenia*, which bears his name, was found in dense masses by Mr. Shrubsole, whilst on a marine excursion off the Isle of Sheppy; and other beautiful forms have been similarly discovered by diligent searchers.

The material brought up by the sounding-line often furnishes subjects for study, more especially the Diatomaceæ, Foraminifera, and Polycystina. The dredging operations of H.M.Ss. "Challenger" and "Porcupine" rendered immense service in this particular, and I think the readers of our journal would not find it a difficult task to imitate their proceedings on a smaller scale during the ensuing summer. Some four or five pieces of rope-yarn, with the ends unravelled, attached to a short iron bar, and this in turn fastened to a line of sufficient length and strength, will furnish a dredge of much the same character as that employed by the naturalists of H.M.S. "Porcupine." When dragged over the bottom of the sea the rope-yarn becomes filled with objects of interest; and on carefully washing will yield a rich harvest as a reward for the labour expended.

Enough, however, has been said on the collection of the Diatomaceæ; and I would merely add, in closing the first part of my subject, that whilst general instructions are useful, it is not advisable implicitly to follow an arbitrary rule as to the habitat of any distinct species, remembering after all that—*experientia docet.*

Some Further Researches on Tubifex.

By A. Hammond, F.L.S.

Plate 16.

IN the following pages I purpose to correct some statements made in my former papers on this interesting annelid,* and to add some new facts, the result of more extended observations on the economy of these worms. I may state that in order to obtain the Tubifex for observation I adopt the following plan, viz., I take a small garden-trowel, a wide-mouthed bottle, and a shallow hand-net, composed of a piece of wire bent into a hoop, about six inches in diameter, and covered with a piece of net, such as is used for ladies' caps, and made in such a manner as to show but little slack when filled with a small quantity of the fine mud in which the worm lives. The mud containing them is taken up with the trowel and placed in the net; when the latter is agitated on the surface of the water, the mud will be washed away through the meshes of the net, leaving nearly all the worms it contained, together with probably sticks, leaves, and other *débris*, on the upper surface. After having got rid of as much of the mud as is possible, the net is turned upside-down over the bottle, which should previously have been partially filled with water, and the contents washed into it; the process being repeated until a sufficient number have been obtained. The chief object at this time to be aimed at is to get rid of the mud; small sticks and stones will not matter. On reaching home, our captives should be turned out into a plate or shallow dish, and covered with about half an inch of clean water, where they will live for two or three weeks, or perhaps longer; giving ample opportunities for watching them. If the water should become thick or muddy, pour it gently off over the edge of the plate (the worms will not follow); and fill up again with fresh water.

On reviewing my first paper, which appeared in Vol. I. of this Journal, I may state that I believe the tubes there spoken of as having been found on the surface of the mud, were undoubtedly

* See Vol. I., p. 14, and Vol. II., p. 165 of this Journal.

the work of the Blood-worms, or larvæ of *Chironomus*, and not of *Tubifex;* and I can only repeat the statement in my note (Vol. I., p. 15) that I have never been able to see the tubes stated to be made by the latter. I cannot allow that the tracks which the worms sometimes make, and which may remain for a few seconds after their passage through the mud, are tubes, any more than that the foot-prints of a man are his dwelling place. These worm tracks show no consistency, and disappear almost immediately with the least disturbance of the water, or even without it. A tube must necessarily have some consistency. *

With regard to the relations of the two fluids found in these and other annelids, viz., the red vascular fluid and the colourless corpusculated fluid occupying the perivisceral cavity, it may be interesting to quote Prof. Lankester on this subject. He says:—"It is not yet apparent which of the two fluids should be called blood, and recognised as the homologue of that fluid in the vertebrata. . . . The following view, which tends to explain this matter, and place it in a clear light, is put forward by my friend, Prof. Busk. In vertebrata the blood can be separated into two parts—the red corpuscles and the clear white plasma with the white corpuscles. The function of the red corpuscles, it is generally admitted, is to carry oxygen; it, in fact, is respiratory. The function of the plasma on the other hand, with its white corpuscles, is simply nutrient. Assuming that this is a correct view of the case, since it is supported by many and conclusive facts, and, indeed, is very generally conceded, let us turn to the Annelida. We find a red fluid, undoubtedly devoted to respiratory purposes, in many genera, and a colourless plasma, with white corpuscles, bathing all the organs of the body. The conclusion is, obviously enough, that the red vascular fluid represents simply the corpuscles, whilst the colourless, corpusculated fluid is homologous with the white plasma of vertebrated animals. It would be unsafe to draw any conclusions as to the respective functions of the fluids from this comparison. The functions of the two fluids in the annelida have yet to be much studied; all that zoologists at present appear to be agreed upon being that, the red vascular fluid is the chief

* If any of our readers can give me any information on the subject of these tubes, I shall be extremely obliged.

medium through which respiration is effected; how far this function is shared by the corpusculated fluid, or how far nutrition is also a part of the function of the red fluid, are questions to which no decisive reply has yet been offered, though the considerations above adduced would tend (perhaps erroneously) to the conclusion that respiration belongs to the one and nutrition to the other exclusively. In speaking, then, of these two fluids, I prefer adopting such names as 'red' and 'colourless,' or 'vascular' and 'perivisceral' fluids, to using the terms 'pseudohæmal' or 'chylaqueous.'" *

A few words may here be said about the integument. Gegenbaur, in speaking of the integument of the Vermes, says:—"The proper integument is formed, as a rule, of a layer of cells, the elements of which are often so slightly separated that they form a syncitium. † This layer corresponds to an epidermis, which in the Annelida is covered by a homogeneous cuticle, which varies greatly in character, and is a product of the secretion of the epidermic cells." This seems, so far as the descriptive portion of it is concerned, to be a correct description of the integument of the Limicolous Oligochæta, which I have examined; but the use of the terms epidermis and cuticle, so far as they may imply homologies, is a point on which some confusion, if not difference of opinion, would appear to exist, and which I should like to point out, even if I cannot settle. D'Udekem, as I have already stated, describes the integument as consisting of a delicate epidermis, and of a chorion intimately united to the muscular layer. Now, from his further description, it is evident that the epidermis of D'Udekem is the homogeneous cuticle of Gegenbaur and his chorion (corium?) the cellular epidermis of the latter. The same reversal of the term epidermis appears in Lankester's description of the integument of the Earthworm, ‡ where 'epidermis' is again applied to the external structureless layer; the cellular layer beneath it,

* The Anatomy of the Earthworm, by E. Ray Lankester, Journal Micr. Sci., Vol. V., New Series, page 100.

† A syncitium is that condition of living matter wherein nuclei are scattered in a mass of protoplasm without the protoplasm itself being marked off into separate cells corresponding to the nuclei.

‡ The Anatomy of the Earthworm, by E. Ray Lankester, Journal Micr. Sci., New Series, Vol. IV., p. 260.

which it is to be noted is pigmentary and vascular, having received no distinctive designation that would indicate its homologies.

Now, it may be objected to this that the term epidermis is applied in Vertebrates to the external *cellular* epithelium of the body, and that the term cuticle, employed by Gegenbaur, is the more correct to apply to a homogeneous secreted covering. At the same time, it must not be overlooked that the subjacent cellular layer in the Earthworm and in Limnodrilus is also vascular, a fact which goes far to remove it from the class of epithelial structures, and should make us rather regard it as the homologue of the dermis of the higher animals. In which case the external structureless layer is, so far as position goes, truly an epidermis, but it is difficult so to regard it without admitting that it is not a secretion, but that it is of cellular origin,* which seems quite opposed, not only to my observations, no trace of cells being discoverable in it, but also to the statement of Gegenbaur, who says that in some of the annelids, pore-canals, so distinctive of the cuticular structures of insects, may be seen in it. Moreover, I am not quite sure whether certain mucous pores, which Lankester afterwards describes in the Earthworm, are not of the nature of pore-canals.

The subject seems to raise the whole question of the origin of the cuticular layers of the ANNULOSA, and a further question appears to arise with respect to the annelids, viz., what provision exists for the growth of the structureless layer (if absolutely structureless it be), which we find in them. Insects and crustacea have a provision in their periodical ecdysis for a growth of their coverings, to keep pace with that of the body, but no such provision exists in the worms. The cuticular coverings of the latter, however, are not to be compared for hardness and rigidity with those of the former, and where it is very soft, the growth of the cuticle may be, perhaps, compared to that of the cell-wall keeping pace with that of its contents. In some worms, however, the cuticle is too thick and consistent to allow us to suppose it to enlarge in this way; nor do I quite think it is the case with

* Lowne (Anat. Blow Fly, p. 10) ascribes a cellular origin to the "cuticle or epidermis" of insects, saying distinctly that it is formed of "coalesced cells."

Tubifex. The cuticular and cellular layers of *Tubifex* are best seen in the glandular clitellus which surrounds the generative segments. At the period of maturity, these cells acquire a far greater development than those of other parts; they swell out and distend the cuticle from the muscular layer, and many of them are characterised by a granular appearance, as shown in Plate 16, Fig. 1.

It will be remembered that I have described the setæ as being placed in pouches or invaginations of the epidermis.* D'Udekem also describes them as thus placed, but further examination leads me to reconsider this statement. There is, I think, a common envelope surrounding the basis of all the setæ in a fascicle, and it gives strongly the impression of an invagination of the integumentary layers; but on carefully observing the movements of the setæ this impression is very much weakened, for they do not seem at all to issue from a common orifice, but each appears to penetrate the cuticle by a separate, very minute aperture or pore. If we conceive a piece of board in which are five or six holes placed in a row, thus | o o o o o | and each hole having a stick passed through it. Now, if we bring together the ends of the sticks thus protruding and grasp them with the hand and move them about, we shall have a fair idea of the movement of the setæ in a fascicle. Within the common envelope each seta is, I think, enclosed in its own separate cell, of which it is a secreted product, in the same way as the cuticle is regarded by Gegenbaur as the secreted product of the epidermic cells. †

That this is, indeed, the case with the new setæ which one constantly meets with in course of formation beside the older ones of the fascicle, is, I think, certain, as the cell surrounding the new seta is rendered visible from the more dense and granular character of its contents, and its light-brown colour. Within this cell, the new seta may be seen, at first only its forked tip, and this tip of the full size that it is to have. Subsequent growth takes place by increment at the base; the central swollen portion is the next to appear; and finally the basal portion gradually acquires

* Vol. I., page 17 of this Journal.

† Gegenbaur, Comp. Anat., Bell's Translation, p. 139, says:—The setæ must be regarded as differentiations of the integument of the class of cuticular formations."

its full length. If we consider that the process of cuticular secretion is one that occurs on the external surface of the secreting epithelial layer, it will be reasonable to think that the secretion of a seta (as an analagous process) also takes place on the surface of the cell by which it is produced. Now, to all appearance the seta is placed in the midst of the cell (see Fig. 2). I think, however, that the cell-wall is really invaginated, the invagination taking the form of the forked tip of the seta, and that the cuticular deposit takes place on the surface of this invagination, as shown in Fig. 3. As the seta grows, the invagination deepens, the tip of the seta advances within the cell, and more cuticular substance is deposited at the base, *i.e.*, at the mouth of the invagination. In time the growing seta either forces its way through the wall of the cell which gave it birth, or which is, I think, more likely, the cell-wall adheres closely around it, as in Fig. 5. It ultimately also penetrates the cuticular covering of the worm.

With regard to the method of oviposition, I am enabled to state that the egg capsules which I have drawn in Plate 34, Fig. 16, of vol. ii., are formed around the worm, *i.e.*, around the glandular clitellus which encircles the generative segments. After its formation, the ova and spermatozoa are passed into it, and it is then slipped over the head of the worm, and thus becomes detached; the ends becoming closed in some unknown manner. How the ova make their way into it, *i.e.*, whether they find exit by an oviduct surrounding the vas deferens, as I have stated was Claparède's opinion, or by any other method, I do not as yet know; but the presence of spermatophores in the seminal receptacles must be regarded as the normal condition of sexual maturity—*i.e.*, they are introduced into these cavities, they remain there, and after a period of vital activity they perish there, unless called into functional activity by the act of oviposition, when they find their way into the capsule as it passes over the mouth of the receptacle, and so obtain access to the ova. Whether they enter the capsule, however, as spermatophores, or whether the spermatic filaments from them only do so, remains yet in uncertainty.

I have not yet been able to follow out the various stages of embryonic development, but have on one or two occasions seen the birth of young worms, or rather their escape from the capsule,

previous to which, however, they have ruptured the vitelline membrane in which each is enclosed (see Fig. 10), and may be seen actively moving about within the capsule, seeking for an exit which they at length effect by breaking off one of the soft projecting poles (see Fig. 11). They are then about one-eighth of an inch long (see Fig. 13), and of a white colour; the alimentary canal, which at this time occupies nearly all the space within the body, being filled with yelk spherules, a provision apparently for their sustenance till sufficiently grown to take care of themselves. The vascular system at this time is difficult to detect, not, I think, that the vessels do not exist, but from the absence of colour, as yet, in their contents. The pulsating hearts, however, in the eighth (seventh setegerous) segment have a faint tinge. The hooked setæ are present; one or two only in a fascicle; but the dorsal capillary setæ are slow in making their appearance, and cannot be detected till the fourth or fifth day after birth. The young worms at first consist of about thirty segments. Others are subsequently added by the subdivision of the last segment. There are no indications of the reproductive organs, for the segments in which they are subsequently found present no characters to distinguish them from the others.

I have recently been somewhat interested by the occurrence in these worms of a parasite, *Gregarina sænuridis*, in an encysted condition in the matrix with the ova, and in the segments anterior to this. On the first occasion of finding them I was greatly puzzled with them, thinking I had found some peculiar condition of development in the ova of the worm. I soon, however, recognised the characteristic pseudo-naviculæ in the cysts, and a reference to Gegenbaur at once solved the difficulty. The cysts of this parasite are always found in the matrix, together with the ova; their presence there is, however, destructive to the latter, which either undergo atrophy, or do not come to maturity. A few remains of yelk may sometimes be seen, but never fully-matured eggs, the nutritive juices which should have nourished them being apparently used up for the development of the parasite. A drawing of the cysts is given in two different conditions in Figs. 6 and 7, and of the parasite itself in the act of conjugation from Gegenbaur in Fig. 9. The following extract * will explain the matter :—" The mode

* Gegenbaur's Comp. Anat., Bell's Translation, p. 87.

of reproduction (of the Protozoa) is most exactly known in the *Gregarinæ.* As a rule, multiplication commences by the concresence of two individuals; this generally occurs very early, so that the two individuals which form one body—the anterior end of one being attached to the posterior end of the other (Fig. 9)—go on growing for some time; or conjugation may only take place later when the forms are mature. After this comes a condition of rest, accompanied by encystation, in which the two individuals form a rounded body with a partition between them. Then the partition disappears, and the substance of the body, and also the nucleus, break up into an amorphous mass, from which numerous vesicles gradually arise. From these latter a number of germ corpuscles, called Pseudo-naviculæ (see Fig. 8), on account of their shape, are formed. These gradually fill the whole cyst, and each gives rise to a single very small organism, consisting of protoplasm solely, and this being without a nucleus corresponds to a cystoid. Each of these structures moves about in an amæboid manner, and is gradually differentiated into a young *Gregarina,* after which a nucleus is differentiated in its interior, and it becomes limited externally by a cortical layer. Although conjugation has no exclusive signification in bringing about these processes, as separate *Gregarinæ* are also able to pass through these reproductive processes in just the same way, yet it is not the less important. It points, at least in the cases where it exists, to the necessity of two individuals to bring about reproduction. It is consequently a phenomenon preliminary to sexual differentiation."

The occurrence of Gregarinæ in the Earthworm has been familiar to me, but the cysts do not exhibit the partition so characteristic of these.

EXPLANATION OF PLATE XVI.

Fig. 1.—Epithelial and cuticular layers from the integument of Limnodrilus Hoffmeisteri at the period of sexual maturity; *cc*, cuticle; *ee*, epithelial cells; *mm*, circular; and *m'm'* longitudinal muscles.

" 2.—Group of setæ, with young one forming within cell.

Fig. 3.—Invagination of cell to form seta (diagrammatic).
,, 4 & 5.—Further stages of ditto.
,, 6.—Gregarina sænuridis encysted, showing partition.
,, 7.—Ditto, ditto, enclosing vesicles.
,, 8.—Pseudo-navicula.
,, 9.—Gregarina sænuridis in act of conjugation (Geg.) ; *a* and *b*, the two individuals ; *c.c*, their nuclei.
,, 10.—Young worm within vitelline membrane.
,, 11.—Pole of capsule with end broken off by exit of young worms.
,, 12.—Capsule, with young worms.
,, 13.—Young worm, immediately after its escape from the capsule.

Results of a Microscopical Investigation of the Action of Ammonium Molybdate and other Chemical Agents on the Vascular and Cellular Tissues of about 120 Different Plants.

By Thomas Spearman Ralph, M.D., Pres. Mic. Soc., Vict.

THE investigations I have made with chemicals on Vegetal Tissues, and which form the subject of my present communication, have arisen out of an examination of various plants with reference to their protoplasmic cell-contents. Simultaneously with this, I was carrying on an enquiry after further evidence of the presence of Bacilli in the tissues of living plants, a subject to which I directed attention last year in May. These investigations have been in great measure closely related, but the leading feature has been the investigation of the action of chemicals on the cell-contents of leaves. With regard to Bacilli, or Bacterial forms, besides their occurrence in Vallisneria cells (and concurrent with the phenomenon of cyclosis), I have met with these organisms in *Anacharis*, and in the cells of *Arum Œthiopium (Richardia ?)*, *Vinca major* (variegated form), *Erythrina*, and in the leaves of Tea after infusion.

The experiments on protoplasm recorded by Mr. Gardner in the *Quart. Journal of Microscopical Science*, induced me to make further experiments, and briefly, I have to state, I have employed

several agents with a view to exhibit the contracted condition of the protoplasm in vegetal cells.

The best plant I have met with, and one well suited for class demonstration, is the *Tradescantia virginica*, or American Spiderwort. The cuticle of the inferior surface of the leaf, carefully peeled off and treated with various reagents, readily exhibits the protoplasm contracted in the cells, with fine fibrils reaching out to the cell-walls. The sepals, also, prepared in the same way, exhibit this condition very beautifully. *Arum* also exhibits these changes very well. At first, I used the Sulpho-Cyanide of Potassium, but this agent acts too rapidly in most cases, unless much diluted, as the protoplasmic mass completely detaches itself from the cell-walls and assumes a globular form, without presenting any fibrils connecting it to the cell-wall. Another plan is to employ salt, as mentioned by Mr. Gardner, and having obtained the change in the protoplasm, wash out the salt by the addition of water to the specimen, and then add a solution of Ammonium Molybdate, and watch the effect.

In *Tradescantia*, this chemical agent usually leads to a feeble yellow tinting of the protoplasm; so rendering it more visible in its divided form.

Ammonium Phosphate also exhibits the protoplasm in a contracted state; so also the Liquor Sodæ Chlorinate of the Brit. Pharmacopœia, when diluted to one-tenth with water. Sulphocarbolate of Soda, followed by the Molybdate, gives a tint to the protoplasm. The employment of the Sulpho-Cyanide is well worth trial, as when this substance is applied to the epiderm cells, apparently possessing no contents, a large globe of protoplasm is seen to separate itself into the centre of the cell.

The above-mentioned use of Ammonium Molybdate led me to make further trial of its chemical action on the cells of leaves; and in consequence I have obtained some curious results in connection with its employment. The Molybdic salt, by itself, will generally attack the hypoderm (cells beneath the epiderm), and tinge them of all shades of orange, from the palest yellow to a deep-red orange. In some cases, this change is not brought out. In others, where the reaction is weak, the colouration is vividly brought out by the further addition of Sulpho-Cyanide of Potas-

sium. Hence we have plants which entirely refuse any reaction; others in which it is feeble, and becoming decided by the addition of another chemical; others, again, in which the Molybdate acts vigorously alone. In a few instances, there seems to be a difference in colouration between the upper and the lower epiderm.

We have, during many years past, been employing aniline dyes to tinge vegetal cells, and have at length succeeded in obtaining a triple or multiple staining of the cells of some plants. Yet these results, to my mind, are not of the nature of a true chemical reaction in cell-contents, but rather a staining effect upon the cell-walls; the cell-contents appearing to have been done away with in the process of preparation.

As the results obtained by the use of the Molybdate are varied, so in measure we obtain some differentiation; for, in some instances, only some cells appear to be acted on, the others either refusing to react, or doing so very slowly.

Further, the chlorophyll appears in some cases to have undergone some process of disintegration, these being full of fine yellow molecular matter, which often exhibits molecular or swarming motion for a time.

The colouration in some cases appears to be affected by the addition of alcohol, used for the purpose of dehydrating the specimen, but, on the whole, it is permanent, and will bear to be mounted in Canada Balsam. When mounted in Glycerine jelly, some of these specimens make fine objects for examination, the vascular tissue between the cells taking colour. Still, these specimens do not come up to the beauty and elegance of a neatly coloured aniline preparation—red and green, etc.

I have now experimented on over 120 different plants, employing various parts, such as portions of the stem, leaf-structure, hairs, petals, and seeds, with varying results; and I am in hopes this mode of chemical examination may lead to some definite results, when the experiments have embraced several hundred kinds of plants. To the physiological botanist this process will prove interesting if not useful, for the effect, when fully obtained, presents variations which are very pleasing; and inasmuch as the specimens can be readily prepared, there will be, I think, a great advantage in making a fair collection of such objects. I am

quite unable to explain the nature of the chemical change brought about—some of my friends suggesting that it is due to the presence of phosphorus in some form of combination; but I am inclined to regard it as a form of oxydation of the cell-contents. I give the results of my observations on 120 genera, placing them in their ordinal relation to each other, the sign × signifying a decided result or reaction; — meaning a moderate or partial; and o, no change worth recording.

The plan I have adopted is as follows:—I obtain the cuticle of a leaf, preferably from the under surface, by peeling it off, or shaving it off with a lancet or sharp knife. This last can usually be effected without much difficulty; but when the upper cuticle is required, then the process of cutting becomes more difficult. If the leaf is folded over the finger and held firmly, the lancet will slice off a thick and thin portion sufficient for observation. I then place the cuticle, with its surface, on the slide, the cut portion uppermost, and applying water, I add a small drop of Ammonium Molybdate solution, and watch the effect.

Usually, in a short space of time, one notices the effect of the reagents by the colour produced in some of the cells, varying from a pale lemon-yellow to a deep orange tint. This colouration usually first appears in the cells of the epiderm, and spreads to the hypoderm, or next layer of cells, and invades the cells of the vascular portion of the leaf. If there is no reaction, or one that appears uncertain, I add a drop of the Sulpho-Cyanide solution, and often the colour deepens. When I wish to preserve the specimen in Canada Balsam, I gradually introduce diluted, and then stronger alcohol, which seems to precipitate the salt in a resinous-looking cloud, and which I remove by further addition of alcohol, and removing the specimen to a clean slide, drop on the Canada Balsam, without heat if possible. In some cases, I first alcoholise the specimen to be examined, and then add the Molybdate, and I am inclined to think the alcohol acts on some of the cells as to their chemical character, and that when the Molybdate takes effect, it does so only on those cells which have escaped the action of the alcohol, as the coloured cells appear to be fewer compared with other specimens of the same leaf differently treated.

I consider it will be necessary to go over these experiments at

some future time, making them on the same plants during varying conditions of growth and season, so that, perhaps, some of the plants I have recorded as unaffected may react when experimented on at an earlier or later stage of their growth. For instance, some months ago I demonstrated the formation of acicular crystals in the leaf of the *Brotera mellifera*, after heating with water. The field becoming absolutely full of these crystals resembling the pappus heads of a Composite flower; but now at this season, when the young leaves are making their appearance, I can get no such result.

There has not been sufficient time to extend observations on the petals of various plants, but I believe a difference will be found in many; as, for instance, these organs reacting under chemicals, but the hairs of the same plant remaining nearly, if not quite unaffected by the reagent.

The examination of seeds will prove most interesting, as well as profitable, and experiments in this direction should be duly recorded in some publication devoted to natural history.

So also this mode of chemical treatment may be extended to the ovules of plants, and perhaps be available in demonstrating the action of pollen tubes. From some slight observations, I think this kind of reaction should be extended to the Fungi—I mean to epiphytal and entophytal forms—so as to endeavour to trace their mycelia in the living tissues, inasmuch as they appear to draw their nutrition from them, and their mycelia may yield some colouration, and so lead to their more ready detection. I have not been able to experiment on the Lichens, nor the Algæ. Five kinds of Ferns have been tried with differing results.

It might be supposed that the Ammonia in the reagent produces the changes in the cells; but I have found Potassium Molybdate and Sodium Molybdate quite as effective.

Molybdic Acid alone acts feebly in some cases, but by the further addition of Soda or Potassa a rapid and decided reaction has followed.

I consider we have fair evidence of the colouration being due to the Molybdium. The general mode of treatment is so easy and the results are so remarkable, I feel satisfied this mode of investigation will give work to a class of observers, who, not being

deeply versed in phytological lore, may yet thereby find employment and scope for their energies, and at the same time furnish materials for the higher-trained botanist to work out.

The following is a summary of results. Of about 120 genera examined, 34 yield no results under the action of Ammonium Molybdate, either alone or followed by Potassium Sulpho-Cyanide. This furnishes a fair per centage, indicating some decided chemical difference in the plants experimented on :—

34, none.
15, partial.
71, complete.

120.

This subject of investigation is a large one, and will require the co-operation of many workers, spread over several seasons, before reliable results can be obtained as to any ordinal or generic value of these reactions. Whole families appear to be acted on, as the *Myrtaceæ* and *Proteaceæ*, while others exhibit breaks. The Monocotyledons, I suspect, will prove to be little affected.

I have arranged the plants I have examined in some general related form, but I think it well to indicate what plants will best and most readily illustrate the matters of this paper :—*Robinia*, or False Acacia, Peach, *Eucalyptus*, *Xanthium* or Bathurst Burr, *Ceanothus*, Loquats, Walnut, *Schinus* or Pepper-Tree, Jasmine, Honeysuckle, Morton Bay Fig. The deciduous stipule (?) or bract overtopping the early form of the leaves exhibits the latex vessels very beautifully coloured by the reagent, as also the petiole and cells of the leaf proper.

I prepare the Ammonium Molybdate solution by saturating the Molybdic Acid with Liquor Ammoniæ, and allowing any free Ammonia to evaporate. The solution can be diluted freely. In some cases, the slightest portion of it on a slide, or on the finger, reacts before one is aware of it, as may happen when many specimens are examined at one sitting.

Table of Genera Examined.

Acotyledons.

Filices.

o Pteris umbrosa, ?
o Adiantum œthiopium.
× Polypodium Billardieri.
× Lomaria, sp.
× Todea rivularis, ?

Monocotyledons.

o Pampas grass, Arundo.
× Arum Lily, œthiop. and maculata.
o Iris.
o Vallisneria spiralis.
o Scilla.
? o Allium (Onion).
— Tradescantia virginica.
× Hedychium, sp.
× Canna indica.
o Triglochin, sp.
o Aponogeton distachyon.
× Musa (Banana).
× Zingiber off.
o Maranta vittata.
— Nymphæaceæ, genus.

Gymnogens.

× Araucaria.
× Podocarpus.

Dicotyledons.

— Salix Babylonica.
× Humulus lupulus (Hop).
? o Morus nigra (Mulberry).
× Ficus macrophylla (Morton Bay Fig).
— Edible Fig (Carica).
× Juglans regia (Walnut).
× Croton (ricinocarpus).
o Buxus sempervirens (Box).
× Ricinus communis(castor oil)
o Gourd.
× Aberia caffon.
× Sterculia diversifolia.
o Hibiscus, sp.
o Phytolacca decandra.
o Brassica (Cauliflower).
× Reseda odorata (Mignonette).
o Polygala myrtifolia (Cape).
× Magnolia tomentosa.
? o Faba (Bean).
o Cassia, sp.
? o Pisum (Pea).
Dolichos lignosus.
o Cytisus, Laburnum.
× Robinia hispida.
× Acacia, sp.
? o Amygdalus communis (Almond).
× Peach.
× Prunus domestica.
× Photinia serrulata.
× Hawthorn.
× Eriobotrya Japonica (Loquat)
× Rosa Banksia.
× Spiræa, sp.
— Ulmus (Elm).
× Ceanothus Africanus.
× Carissa ovata.
o Hoya carnosa.
o Imperialis.
o Vinca major (Periwinkle).
— Erythræa, sp.
Ligustrum (Privet).
× Solanum (jasminoides).
× Nicotiana (glauca).
o Physalis (Cape Gooseberry).
× Cestrum.
— Datura (section of).
× Habrothamnus fasciculatus.
— Ipomœa purpurea.
× Corynocarpus lavigatus (N. Zealand).
× Jasminum, sp.
o Myoporum deserti.
— Tecoma Australis.
— Acanthus mollis.
× Digitalis purpurea (Foxglove).

DICOTYLEDONS—*continued.*

Veronica Andersonii.
o Valeriana off. (garden).
— Daphne variabilis.
× Xanthium (Strumarium), Small Burdock.
× Senecio, sp.
× Myrtus communis (Myrtle).
× Mecylon (tinctorum).
× Tristania laurina, ?
× Eucalyptus globulus.
× Fabricia lævigata.
o Pereskia aculeata.
× Escallonia macrantha, ?
o Coprosma lucida.
× Lonicera xylostum (Honeysuckle).
× Viburnum tinus (Laurestina).
o Sambucas nigra (Elder).
o Aralia papyrifera (Rice Paper).
o Panax, sp.
— Hedera Helix (Ivy).
× Umbelliferæ, 2 genera.
× Clematis (garden).
— Aquilegia (Columbine).
× Pœonia offic.
o Eschscholtzia Californica.
× Papaver Somniferum.
o Dielytra spectabilis.
Berberis.
× Vitis vinifera (Vine).
× Pittosporum undulatum.
× Arbutus unedo.
? o Citrus (Lemon).
— Melia (Azadirachta).
× Schinus molle (Pepper Tree)
× Ailanthus glandulosa.
? Oxalis.
× Melianthus major.
× Impatiens (Balsam).
× Pelargonium, sp.
Rheum (common Rhubarb).
Mirabilis (Marvel of Peru).
Bougainvillea.
× Daphne.
× Protea mellifera.
Do. cynaroides.
× Telopea speciosissima (Waratah).
× Hakea elliptica.
Do. laurina.
— Stenocarpus, salignus.
× Lomatia ilicifolia.
× Buckinghamia celsissima.
× Helicia.
— Grevillea Hilliana.
× Leucadendron argentum.
× Laurus.

Specific names have not all been given, as most of the specimens have been obtained from gardens, and uncertainty might be introduced.

This paper was read before the Microscopical Society, Victoria, 31st January, 1884.

The Microscope in Palæontology.

By Malcolm Poignand, M.D.

Plate 17.

THE Palæontologist, working at the scanty and imperfect remains of the fauna of long past ages found scattered through the deposits of former seas and rivers, with a view of picturing life as it existed in varied conditions through all the vast periods of geological time, has to fill up many a wide gap in the records of the past by his knowledge of the present; and in doing this, he labours under a double difficulty, namely, that the old remains are often only mere fragments of damaged skeletons of organisms having a most distant resemblance to their nearest modern representatives, and also that all is not by any means known or settled about the new.

In dealing with a problem so difficult, no fact, however minute, can be neglected; for it may be a link, however small, in a wonderful and complex chain. Thus, every detail of microscopic structure becomes of real importance and interest, and it is easy to see how the use of the microscope, especially when directed to the examination of transparent sections of rocks and fossils showing details of internal structure, has thrown a flood of light on what was dark and obscure before.

Besides the many fossils, which from their minute size could not otherwise be known at all, whole series of rocks have been found to be mainly composed of organic remains and *débris*.

Frequently, the fossil under examination may prove on section only a more or less perfect cast with every detail of internal structure gone, and the cavity occupied by a crystalline or an amorphous mineral mass, so that even the hard shell structure has vanished, and the plant tissue become a mere film of carbon; all degrees exist between this total loss, and thôse fossils in which silica, or calcite, has preserved the most delicate structural details without distortion or disarrangement. At times scarcely a change appears to have taken place, for the brown chitin of Scottish carboniferous scorpions is hardly distinguishable from that of recent

species, and probably as little change has taken place in the dermo-skeletons of the insects mummified in fossil resin, considering the almost perfect condition of insects found in Amber.

The microscope gives a fresh value to a fragment of tooth or shell, too imperfect to be determined without a section, which will frequently show minute, but characteristic structure ; and yet such a fragment may serve to identify the nature of the formation in which it was found ; a matter not only of importance to the Palæontologist, but also to those in search of minerals or water, for the small core which the boring-machine brings up must often of necessity contain but scanty evidence of the nature of the strata through which it has drilled, and yet, on an accurate knowledge of these strata, success in many cases depends.

Time and the use of the microscope must decide as to the probability of organic remains being ever discovered in the archæan Limestones, or of organic structure being traced in Laurentian Graphite. The well-known Eozoon was thought for awhile by some to have settled the question in part, but its mineral nature and origin is now generally admitted.

With regard to the Eozoon, in any case, the storm of controversy which raged around it should prove useful as a warning. How difficult even skilled observers find it at times to distinguish in mixed and infiltrated minerals, what is due to strictly mineral changes alone, and what to their modification, by the presence of organic remains. Many fossils, even when their internal structure seems best preserved, are only, either a complicated series of minute casts, as many fossil sponges, or exist simply as stains in the silica, which has, atom by atom, replaced those which once composed the organism, leaving only some of the molecules of carbon, iron, or lime with which it has entered into combination, without disarrangement of their original distribution, so that they thus remain to map out, in a sort of solid photograph, in permanent type, many most beautiful and minute details of structure. These ghosts of former structure remain, though not so easily traced, even when the silica itself has in the course of time undergone a molecular change, having passed from the colloid to the crystalline state, for crystals are formed without regard to the presence or absence of organic impurities in the matrix, and the pattern of the structural remains becomes obscured by them.

Having briefly sketched the use of the microscope in Palæontology generally, a few instances of its innumerable uses may be noticed more in detail. Commencing with Bones. These, if any articular surface is preserved, can generally be determined with a moderate amount of ease and accuracy; but if occurring waterworn and rolled, gnawed at the articular ends, or in small fragments, microscopic sections may be of value, as by means of a careful examination and measurement of the average size of the long and short diameters of the lacunæ, and consideration of the arrangement of the Haversian canals, and of the canaliculi of the lacunæ, combined with other details less microscopic, a bone may be classed. And as instances. It is well known how Dr. Falconer was thus aided in determining one of the toe-bones of his gigantic Indian tortoise. Again, the first large Pterodactyle bone found in the chalk was the subject of much discussion on account of its size, until a comparison of microscopic sections settled the question, and future discoveries not only confirmed this, but removed all doubts that its size had raised.

Taking as our next example, Teeth. These being always most intimately related to the food and habits of the animal, become of the utmost importance to the palæontologist in the determination of the nature and affinities of extinct species, of whose organisation, from the durability of their tissues, they are often the sole remains discoverable in the deposits of former times. From the external examination of worn fragments of teeth, little indeed could be said about their former owners; but a magnified section may reveal the most characteristic structure, such as the complicated infoldings of cement through the waving lobes of dentine in the teeth of the Labyrinthodonts, a group in which size is no guide, as they vary from a few inches in some species, even when adult and perfect, to others which attain the huge bulk of the Mastodonsaurus.

Amongst the teeth of extinct mammals, birds, reptiles, and fishes, the microscope demonstrates innumerable variations and modifications in the substance and use of dentine, enamel, and cement, the three components of a typical tooth, and the polariscope at times aids in showing the structure. Moreover, the teeth of many extinct genera display a structure, mode of growth, and

renovation exactly the same as their modern representatives, though they may widely differ in many other respects.

Taking as an example the huge, extinct *Megatherium* and the modern diminutive representative, the sloth (see Pl. 17, Figs. 1, 2). The teeth of the modern two-toed sloth differ, in presenting a greater inequality of size than those of the Megatherium, but almost all the other dental characters are the same. The teeth of the Megatherium may be described (see Fig. 3) as a central axis of vaso-dentine, surrounded by a thin layer of hard, or unvascular dentine, which is coated by cement. The vaso-dentine is traversed throughout by medullary canals, measuring 1—1,500th of an inch in diameter, continued from the pulp cavity, and anastomosing in pairs by a loop, the convexity of which is turned towards the origin of the tubes of the hard dentine. The cement is characterised by the size, number, and regularity of the vascular canals which traverse it, running parallel to each other, and anastomose in loops, the convexity of which is directed towards the hard dentine. All the constituents of the blood freely circulated through the vascular dentine and the cement, and the vessels of each substance, intercommunicated by a few canals, continued across the hard or unvascular dentine.

The minuter tubes, which pervade every part of the tooth, characterising, by their difference of length and course the three constituent substances, form one continuous and freely intercommunicating system of strengthening and reparative vessels, by which the plasma of the blood was distributed throughout the entire tooth, for its nutrition and maintenance in a healthy state. The oblique direction of the vessels of the vaso-dentine has a use, probably, in thus maintaining the nutrition of the hard dentine at the tip of the tooth, although the vaso-dentine at its level has been worn away.*

Scales and carapaces of many reptiles are often sufficiently well preserved to show their structure, and the curious bodies found in the coal measures, and supposed to be modified ossicles of the ventral armour of some genus of Labyrinthodonts, await a microscopic examination, which will probably help in determining their origin. Scales of many fishes require magnifying and careful

* Owen's Anatomy of the Vertebrates, Vol. III., pp. 274-5.

use of oblique illumination, to show their fine markings. Coprolites in section reveal with certainty details in the *menu* of ancient feasts, and in sections of worm-eaten coniferous wood coprolites of the smallest size have been found.

Dr. Carpenter has investigated a great number of the shells of Brachiopoda, and made out, by careful microscopical examination of transparent sections, a number of interesting and valuable details relating to their structure, the arrangement and markings of their prisms which form the shells; and the presence or absence, in the various groups, of the curious canals which penetrate the whole thickness of the shell. These canals (so far as yet known) exist in all true *Terebratulidæ*, and are equally wanting in all true *Rhynchonellidæ*, but in other groups they exist in some species only, and not in others.

Many of the shells of the *Brachiopoda*—*e.g.*, *Porambonites reticulata*—have punctations, but no canals, though on external examination the decided and regular pitting of the surface of this shell closely resembles the large punctations caused by the openings of the canals in some of the *Terebratulidæ* and *Spiriferidæ*.

Dr. Carpenter has also shown how the shells of brachiopods differ from ordinary bivalves in their whole shell-structure, corresponding to the outer layer only of *Lamellibranchiata*, being, in fact, calcified epidermis, like the prismatic external layer of *Pinna* or *Avicula;* and so characteristic is their structure, that even minute fragments may be referred with certainty to this group, provided metamorphic action has not altered their minute structure, as only too frequently occurs. Many shells are of course so minute that they have to be magnified for their forms to be examined; but many small shells have very fine markings, or spines, and even in a few cases minute impressions from the former soft parts of the mollusc, whilst some comparatively large shells have their ornamentation arranged in a minute pattern.

Leaving out entirely many classes whose investigation has received aid from the microscope, Corals may be noticed as instances in which sections have done so much, and the beautiful arrangement of septa and tubulæ demonstrated, and mural pores shown, and other details of the calices made out.

Sponges, again, have of late been the subject of much micro-

scopic study. Dr. Bowerbank said of recent English sponges that after fifty years' experience of them, he frequently found that a guess at the species by external examination, of even the commonest kinds, was frequently wrong; but that a section at right angles to the surface under the microscope settled the question with ease and certainty. Different genera of sponges may assume the same form, and diverse forms may belong to the same genus or even species. How much more, then, must microscopic sections be required, in dealing with the damaged and altered remains of fossil sponges!

Mr. Sollas describes some of the changes which fossilisation causes at times in Hexactinellid sponges: how crystalline, transparent calcite fills up the meshes of the network, and occupies the hexradiate canals of the siliceous fibre, and encloses the fibre, in a few cases, almost as homogeneous and purely siliceous as when it existed in the living state; but more generally, specimens shew a further change. The siliceous fibre becomes granular, absorption takes place mainly from within outwards in each fibre, and calcite is concurrently deposited. But even in this extreme mineralogical change, the original structure is not obliterated. The calcite which fills the internal canal and the interspaces of the meshes is transparent and usually colourless, or with faint yellowish tinge; while that which replaces the siliceous fibre is, by reflected light, of a milky-blue colour, and by transmitted light, brownish, less transparent, and granular, with dark spots. And thus, while the fundamental spicule has become absorbed and its hollow cast filled with crystalline calcite, and the same material has replaced the siliceous fibre, and the sarcode between the meshes; while, in fact, the whole of the metamorphosed net consists of one material, carbonate of lime, the structure is left as definitely recorded as in a sponge, with its natural composition only just dead.

Other and further changes at times take place, and when the sponge is partly fossilised by calcite externally and silica internally, the central canal is often once more absorbed, and again, as in its primary state, filled with silica. This may be changed, silica again taking possession of the form of the fibre, and minute granules of iron pyrites taking up the form of the central canal. The remains of the first-known sponge, the Cambrian *Protospongia*, was pro-

bably originally siliceous, but is now iron pyrites. Owing, apparently, to some difference in the refractive index of colloidal and crystalline silica; fossil siliceous fibres and spicules, mount much better in Glycerine jelly than in Canada balsam. Recent spicules, on the other hand, are invisible in Glycerine jelly, but the fibre is more than usually well defined. Recent calcareous spicules polarise well, but siliceous spicules do not.

Foraminifera and Polycystina and many other orders are almost entirely microscopic, and are too well known to need any notice, however brief. Fossil botany, also, is an extensive subject, and one in which the knowledge of microscopic structure is all-important, and roots no longer do duty for branches, and rootlets for leaves, as they did formerly, when external appearance was taken as the main, if not the only guide.

In conclusion, I believe that you will find that the use of the microscope in Palæontology greatly aids in drawing these conclusions; that though time and external appearances may widely separate various beings, yet that they all bear definite relations to each other, and follow the same laws; that the life-history of the individual, from its earliest stage to adult perfection, runs parallel with the life-history of the race, and that as the pedigree of many existing beings can be roughly traced in the annals of the past, what is true of a part will ultimately be found to be true of the whole, so that the old and the new are not really separate, but form a portion of a wondrous and complex whole, which, although for ever slowly changing, seems for ever to lead to greater complexity and beauty.

EXPLANATION OF PLATE XVII.

Fig. 1.—Section of upper jaw and teeth of the Megatherium, one-third natural size (after Owen). The teeth are five in number on each side of the upper jaw, as drawn, and four on each side of the lower jaw. *p.*, the pulp-cavity, which is unusually extensive, and from the apex of which a fissure is continued to the middle depression of the grinding surface of the tooth. *v.*, the vaso-dentine, the central axis of which is surrounded by a thin layer of hard or unvascular dentine, *d.*, and this is coated by the cement, *c.*, which is of great thickness on the anterior and posterior surfaces, but thin where it covers the outer and inner sides of the tooth.

Fig. 2.—Teeth of the two-toed sloth, *Cholœpus didactylus;* the first of the upper and lower series, from their length and peculiar form, are called "canine."

,, 3.—Magnified section of molar tooth of the Megatherium :—*v.*, vaso-dentine ; *t.*, dentine ; *c.*, cement.

Diamonds and their History.

By James A. Forster.

SECOND PART.

WE have now to consider the occurrence and geological distribution of the Diamond, more especially in South Africa, where for the first time in its history the Diamond has been found in its parent rock.

The Diamonds known to the ancients undoubtedly came from India, perhaps from the fabled mines of Golconda. These mines were really not situated at Golconda, but some distance from that place, which was merely the fort to which the produce of the mines was brought. In the 16th century, Diamonds were energetically sought for in India. Of the actual mines there we know but little; the Portuguese author, Garcias ab Herta, writing in 1565, gives some description of them, but his work is not of much scientific value, beyond establishing the fact that the Diamonds were washed from a pebbly gravel. Tavernier, the French traveller, a century later, describes the Indian Diamond-fields, many of which, he informs us, were then closed, and confirms the statement that the Diamonds were either found in river-beds or washed from alluvial gravel. Recently, I gave a geological friend of mine who happened to be in India a commission to survey the old Diamond district in the Madras Presidency, my firm then holding the concession for working it. He made the survey very carefully, and reported that the district had evidently been thoroughly worked out. The specimens of the gravels he sent me are very similar to those from Brazil. At present, very few Diamonds are found in India, and scarcely any rough from there finds its way to Europe. On the contrary, large quantities of rough and cut Cape Diamonds are sent to India by the London merchants.

Borneo produces a few Diamonds, but of the mines there we know nothing beyond that the district is said to be fearfully unhealthy, and that Europeans cannot live there. According to tradition, Diamonds are said to have been found in Arabia, but this I believe to be entirely a myth. Mineralogical treatises also state that Diamonds have been found in the Ural Mountains; however, I can find no satisfactory records of such finds, and it is certain none come from there now, and the asserted discoveries in California, Georgia, and Mexico are without foundation, and, like the reported finds of Diamonds in Arizona, have, no doubt, resulted from "salting" operations by speculators who wished to sell a Diamond-mine.

Australia has produced Diamonds of small size, washed from the banks of rivers, but only in such small quantities that they have not paid for the seeking, although it would seem probable, judging from our experience at the Cape, that districts rich in Diamonds may be discovered in New South Wales.

The Brazilian mines were first discovered in 1727, in Sierro de Frio, and produced immense quantities of Diamonds, so as to cause great consternation amongst the possessors of old Diamonds, and a considerable fall in values. Later on, other diamondiferous districts were found, and in 1843 the rich fields of Bahia were discovered. At this time, the total annual finds amounted to the astonishing quantity of 600,000 carats, worth over a million sterling.* This production, however, was not maintained for long, and by 1851 had fallen to one-fourth, and was diminishing year by year. There are three distinct diamond-producing districts in Brazil, widely separated from each other, and evidently each deriving its Diamonds from a different source. The first is the district of Diamantina, in the Minas Geraes; the second some seven days' journey from it, in the district known as Bagagem, and which produces the finest quality; and, third, the district of Bahia, near the sea-coast. In the two first of these districts, the Diamonds are found by washing an alluvial deposit, a peculiarly reddish gravel, known locally under the name of "Cascalhao," which occurs underneath the present bed of the river, and is

* The South African fields have proved much richer, the total finds of the four Mines—Kimberley, Bultfontein, Dutoitspan, and De Beer's—being estimated for the year 1883 at 2,600,000 carats, of the value of three millions sterling.

indeed the ancient bed of the river. To get at this, the stream is dammed off in the dry season, and shafts, from 6 to 30 ft., sunk to this diamond-bearing layer, and the gravel is brought to the surface in baskets by negroes, and stored by the washing-sheds to be examined during the rainy season. The season during which the ground can be excavated is very short; I believe, not above ten weeks, at the end of which time the rains commence suddenly in such deluges as to destroy all works, carrying away the embankments and filling up all the holes, and the following season the miners have to begin again anew, and as all trace of former workings are obliterated, it not unfrequently occurs that a miner sinks his shafts on ground already worked, and thus has the season's work wasted. In this way, and owing to the great difficulties to be overcome, diamond-mining in the Sierras has become a most precarious and dangerous operation. In the third district, that of Bahia, the Diamonds are also found in an alluvial gravel, but instead of occurring in the ancient beds of rivers, this gravel is spread in a very thin stratum over the face of the country, close to, or on the surface, and requires little more than to be raked up and washed. In a locality discovered about a year since, called Canaviras, near Bahia, and now being worked with success, the gravel lies quite on the surface, and forms a stratum not six inches thick, and although the area over which it extends is very considerable, it is estimated it will be worked out in two years. In 1841, a paper was read before the Academy at Brussels by M. P. Chasseau, in which he claimed that in one locality the Sierro di San Antonio di Grammagoa, the Diamond had been found in its matrix rock. He described it as "grès psammite," and it is, I believe, the same as the Itacolimite of other authors, which has been frequently described as a kind of sandy freestone. It is, however, a mistake to suppose that this is the rock in which the Diamond is formed. It is only a somewhat compact conglomerate, formed of the same elements as the cascalhao.

I will now turn to the South-African Diamond-fields, the richest and most interesting in the world. The existence of Diamonds at South Africa had been asserted many years ago, and there is a mission-map, dated as far back as 1750, on which is written, across the district of West Griqualand, "Here be Diamonds," and it is

certain that the bushmen and Corannas have used Diamonds for boring stones from time immemorial, and on several occasions the old Dutch Boers of Capetown were excited about the matter, but the rumours died away, and were forgotten till 1867, when a travelling trader brought some Diamonds to Cape Town, which he had obtained from a farmer on the Orange River. Sir P. E. Wodehouse bought them, and startled the world by sending them to the Paris International Exhibition. Soon the Colony was all agog, and by 1870 5,000 people were digging on the banks of the Orange and Vaal Rivers, where the Diamonds are found in much the same manner as in India and Brazil. These were, however, only what are known as the "river diggings," and were soon to be eclipsed by the so-called "dry diggings" of Dutoitspan, Bultfontein, Old de Beers, and lastly, but more important than all the rest combined, the mine of Colesburg Kopje, called at first New Rush, and now famous before the world as the Kimberley Mine. Here, at last, was the Diamond traced to its parent rock, to its matrix, to the place of its crystallisation. Before describing the mine, let me draw your attention to the general characteristics of the country, although it is at present impossible to give a very exact geological account of it, as no two geologists who have been on the fields seem to agree in their description of the formation. In fact, there are not yet data sufficient to draw up a good geological map of the district. Kimberley is situated some 600 miles north-east of Cape Town and about 24 miles south of the Vaal River. The country, which is barren and sterile to a fearful degree, seems to consist to a considerable extent of a loose conglomerate, varying considerably in constitution, resting upon the Karoo shales of unknown thickness, and traversed in all directions by dykes of greenstone and other volcanic rocks. In places are large, superficial deposits of tufa, pebbles, and sand. Peculiar and marked features of the country are the salt-pans (shallow depressions of the land, containing saline deposits) and the low, truncated hills, known as Kopjes. These Kopjes rise 40 to 80 ft. from the plain, have flat tops, and seem to be protruding masses of a rock that has been described as basaltic, and are frequently more or less covered with a loose, fine, red sand. These remarkable hills are now known to be ancient volcanoes, and on such a

hill was 10 years ago Kimberley Mine. The operations there, covering about 9 acres, have now not only levelled the hill, but have excavated the earth to the depth of about 800 feet, laying bare the sides of the crater. As the sand got cleared away, it was found that the "mine" is surrounded by hard, calcined shales, called by the miners "the reef." This reef contains no Diamonds, nor does the stratum outside it, the diamondiferous earth being entirely inside—that is, surrounded by the reef. At first, the reef sloped inwards, thus decreasing the area of the mine, and forming a kind of cup, but at a certain depth it becomes vertical. The first layer was the loose, red sand, containing but few Diamonds; then came a stratum of 60 to 80 feet of yellow ground, containing many Diamonds; and below that the richest stratum of all, known as the blue ground, of unknown depth. This diamondiferous ground has been carefully and thoroughly analysed, and is found to consist of decomposed volcanic material.

The mine, or, more properly speaking, quarry, is worked by negro labour. The "blue ground" is first loosened by blasting, then dug out with pick and shovel, and hauled to the surface by means of aërial trams, worked by steam power. The ground, at first very hard, is then spread out, exposed to the sun and rain, and in about three or four months is in a condition to pulverise and pass through the washing-machine. Space prevents me longer dwelling upon this mine, which may be taken as a type of all the dry diggings of South Africa. They are all, both pans and Kopjes, volcanic craters. This is proved by the calcined reef surrounding them, and the character and analysis of the earth contained inside them; further, that the country has been subjected to great volcanic disturbance, is shown by the stratum being seamed in all directions by trap-dykes. That the Diamonds of the Kimberley mine were formed in the earth in which they are now found, an examination of the output of the mine conclusively proves.

The Diamonds from these mines are entirely different in appearance from those found in the gravels of Brazil, or India, or the "River Diggings," which always bear marks of travel; while these from Kimberley, to the minutest chips, show, by their sharp edges and brilliant polish, that they have crystallised where now found, or at most been only thrown up from below.

There now remains the question of their origin, and from whence came the material from which they crystallised. My theory is, that underneath the shale will be found a deposit of coal, perhaps under the mine, certainly in its near neighbourhood, (a rich coal stratum is now being worked, which crops up to the surface in the Transvaal, about 100 miles distant from Kimberley,) and that subsequently to this carboniferous period the volcanoes were in a state of activity, during which the carbonic-acid gas, evolved from the coal in process of formation, found an outlet into the pipe or crater of the volcano, entering it like a blast. The gas would thus be in the presence of the natural forces necessary to determine its crystallisation, viz., pressure and heat. The changes of temperature that the molten rock in the crater would be subjected to accounts for the shattered condition the Diamonds frequently present; also for the irregularities of their crystallisation. Finally, the answer I would give to the question of "What is the Diamond?" is that it is crystallised sunshine. The solar rays absorbed by the vegetation of the coal-measures now shine forth from these beautiful gems.

On the Study of the Larval Forms of the Crustacea.

BY EDWARD LOVETT, CROYDON.

THE early stages of the Crustacea are less known than are those of any other order of animals; for the insects of our Islands have been so thoroughly worked, that even the life-history of the Micro-lepidoptera have received elaborate description. The Mollusca, too, are fairly well known as to their reproduction, and so, too, are the fishes. Yet the Zoœa, or larval forms of many of our British Crustacea are apparently unknown, and those even of less rare species are strangers to all but those naturalists who have made these interesting creatures their study. It is only within the last sixty or seventy years that

the larval forms of the Crustacea were recognised as such; before that time they were classed under a genus called *Zoœa*, hence the term then given is still applied to them in their real character.

The reason of this obscurity on the part of these peculiar microscopic atoms, for in truth many of them are little more, is not far to seek. Few animals, except our familiar and pugnacious friend the Shore Crab, *Carcinus mœnas*, are so extremely difficult to keep in even the best-managed aquarium, as Crabs, Lobsters, Shrimps, Prawns, and Sandhoppers. And if these animals are not favourable for the purpose of observation, under ordinary conditions, it stands to reason, that when laden with mature ova, they are still less likely to live under artificial circumstances; far more unlikely is it that the tender and fragile Zoœa would be able to undergo this natural metamorphosis whilst subjected to unnatural confinement. I suppose that the nearest approach to perfection in the study of the life-history of these creatures exists in the splendid Marine Zoological Station at Naples, and British naturalists will hail with delight the day when something of the kind can be established in some favoured locality on our own shores.

There is no doubt that the conditions to be aimed at for the successful accomplishment of the object in view are those corresponding exactly with Nature, but unfortunately even the natural conditions under which pretty well half of the British Crustacea undergo their early life are not known. Some of our Crustacea are entirely shore forms, delighting in the zone where the surf breaks with the greatest fury; others are seldom found except under large stones, and in rock crevices; others, again, burrow in sand, in mud, or in rock detritus (each material being characteristic of separate and distinct species); some live in estuaries, others in ditches of brackish water, in salt marshes, and some swim freely in deep water. As therefore the parents exist under so many different conditions, it is probable also that their Zoœa forms enjoy as large a variety of attendant circumstances, but what these circumstances are, in most cases remains a mystery.

There are, however, a few species which may, with a little care, be studied in confinement, one of the best being our little

friend already mentioned, viz.—the common Shore Crab. The hardy constitution of this species is no doubt the cause of its wide distribution. Besides a range of considerable dimensions outside the limits of our own seas, it occurs on almost every possible variety of coast in this country. It swarms in harbours, muddy estuaries, or busy docks; it may be seen scuttling along the wet sand at any sea-side resort; it assumes tints and shades of delicate hue amongst the rich Zostera pools of the Channel Islands, and it lives and attains to a goodly size on the bleak, cold shores of Shetland. If therefore a species be required whose Zoœa could stand the strain, I think this would be the best for the purpose.

And now for the tanks necessary for the "cultivation" of *Carcinus mœnas*. In *Science Gossip* for January last, I figured and described a series of small breeding tanks, fitted with reservoirs, so constructed that when one reservoir was discharging its contents into the top tank, the lower tank, having received the overflow, again discharged it into the other, when, by reversing the reservoirs, by a simple mechanical arrangement, the operation was repeated. This, with occasional attention, would cause an almost perpetual flow of water, and in addition to this, a certain quantity of the reserve sea-water would always be in the dark. The advantage of such a series of tanks as these for hatching out Zoœa of Crustacea is that the water does not become stagnant, and consequently fatal to its inmates. Of course the ends of the overflow pipes should be covered with the finest wire gauze, and sheets of glass should also be placed on the tanks to exclude dust; the bottom of each should be covered with well-washed, coarse sand, and the water itself need not be more than from two to six inches in depth. One of the most important items to be remembered is, that these tanks should be placed in a cool north aspect, with little or no direct sunlight.

Having obtained a female crab, with dark-coloured ova (the dark colour of the ova is a proof of their being near maturity, immature ova being yellow, red, or very pale brown, whereas the mature ova become nearly black as the eye of the Zoœa begins to form), place her in one of the tanks, and supply her with a piece of broken flower-pot, or some such object, under which she can crawl, for some Crustaceans are very shy, and shelter should at all

times be provided for them. The Zocea will leave the parent soon after emergence from the egg, and if carefully looked for may be seen swimming about, but they are mostly tiny little fellows. It will now be possible to record their development, by taking a few every two or three days and examining them under the microscope, making drawings of them at the time, or preserving them as slides for future work.

I will conclude by referring my readers to the *Journal of the Royal Microscopical Society*, Vol. III., Part 6, for December, 1883, p. 785, where they will find a paper by me on an improved method for the preparation and mounting of these and other delicate marine organisms.

Hydrozoa and Medusæ.

By J. B. Jeaffreson, M.R.C.S., etc.

Plate 18.

SCARCELY any result of Microscopic research has been more interesting and unexpected than the discovery of the close connection between the Hydroid Zoophytes and the Medusoid Acalephæ, or Jelly-fishes. So utterly different are they in size, organisation, and mode of life that they were long considered as separate and distinct creatures; but it is now discovered that many of the Medusæ are really only the sexual apparatus of certain members of the Hydrozoa.

The Compound Hydrozoa consists essentially of an aggregation or colony of partially independent polypites or zoöids, almost identical in structure with the familiar pond Hydra; but, instead of leading a separate existence like that animal, remaining permanently connected with one another by a common flesh or cœnosarc. Each group or colony commences its existence as a free-swimming, ciliated, oblong body, called "a planula," very closely resembling an infusorian, which soon attaches itself by one extremity to some solid object; and at the opposite end developes a mouth, surrounded by a row of tentacles. The mouth opens into a chamber,

which occupies the whole length of the polypite, and at its lower extremity is continuous with the tubular cavity which is excavated throughout the centre of the cœnosarc ; and hence the nutritive particles obtained by each polypite serve for the support of the whole colony.

From this original Hydraform polype, a stalk of cœnosarc grows upwards, and on this stalk new polypites are developed; thus giving rise to a more or less arborescent, plant-like colony. One of the best known forms, which is familiar to all visitors at the seaside, is the *Sertularia*, or sea-fir (Fig. 2), which, by those unacquainted with its true nature, is almost always set down as a seaweed. They are entirely confined to the sea, with the single exception of *Cordylophora*, which inhabits fresh water (Fig. 1).

These colonies continue to increase for some time by gemmation, but the polypites thus produced can only remain attached to the original individual, and are unable to start new colonies. For this purpose it is necessary that a special form of polypite should be developed, entirely devoted to the purposes of reproduction. These reproductive gemmæ, which are totally different from the nutritive zoöides, both in structure and function, bud forth from the base of the tentacles. In the simplest form they appear as mere protuberances from the external wall of the Hydrozoon (Fig. 1*a*), forming a sort of sacculated pouch, attached by a short stalk to the parent colony, which after attaining a certain size develop ova and sperm-cells. In *Sertularia* they are developed in chitinous receptacles, known as "gonotheca" (Fig. 2), and remain permanently attached to the parent colony. In the *Corynida* and *Campanularida*, the reproductive elements are developed in distinct buds or sacs, which are external processes of the body-wall, and are termed "gonophores" (Fig. 3*a*). Each gonophore develops into a little transparent, glassy, bell-shaped disc, attached by its base to the parent organism : from its roof, like the clapper of a bell, there depends a peduncle or "manubrium" (Fig. 3*m*); while from the rim hang a row of long and delicate tentacles. In the manubrium is formed a mouth, which opens into the stomach, from which four tubes radiate to the margin of the bell, where they communicate with each other by a single circular canal, which surrounds the disc.

In some species, as *Tubularia indivisa*, the gonophores thus constituted remain permanently attached to the parent organism, but in other cases still further changes ensue. After a time they are detached from the parent, becoming in every respect independent beings, and are absolutely identical with the organisms commonly called "jelly-fishes," and technically known as *Medusæ* (Fig. 3*b*). The essential generative elements—the ova and spermatozoa—are developed in the walls of the radiating tubes which open into the stomach; and these eggs, instead of producing young jelly-fish, give origin to the small ciliated infusorian-like body referred to previously, which after a time settles on some solid object at the bottom of the sea, and develops into the primary polypite of a new colony, which again goes through the extraordinary cycle we have been considering.

In one of the sub-classes of the Hydrozoa—the *Lucernariida*—a further variation of the reproductive process takes place. Here the free-swimming ciliated embryo (Fig. 4*a*) attaches itself to some submarine body, forms a mouth at the opposite extremity, around which are developed a row of tentacles (Fig. 4*b*), and is now known as a Hydra-tuba. It possesses the power of forming by gemmation large colonies, which may remain in this condition for years, but in which state it is unable to produce the essential organs of reproduction. After a time, however, the body becomes elongated, and exhibits a number of transverse depressions or grooves (Fig. 4*c*), which go on getting deeper and deeper till the whole organism assumes the aspect of a pile of saucers one above the other, with their concave surfaces upwards. At this stage the organism was described by Sars under the name of "Strobila" (Fig. 4*d*). The edges of these discs become divided into lobes, each lobe presenting a cleft in the centre. The tentacles now disappear, and a fresh circle is formed at the base of the Hydra-tube. At last the saucer-like segments drop off one by one, and present themselves in the form of independent, free-swimming Medusoids, under the name of *Ephyræ* (Fig. 4*f*). They swim about freely, eat voraciously, and increase largely in size; sometimes becoming absolutely gigantic—specimens having been found seven feet in diameter, with tentacles more than fifty feet in length. As they advance towards maturity they gradually take on all the characteristics of

adult jelly-fish; part of the umbrella-like disc projects downwards in the form of a proboscis (Fig. 4*h*), in the centre of which is a quadrangular mouth, which opens into the digestive sac; from which arises a series of radiating canals which extend themselves over the disc. The intervals between the segments gradually fill up, so that the divisions are obliterated, and from the borders of the disc sprout forth tendril-like filaments, which hang down around the margin; while from the four angles of the mouth prolongations are put forth which develop in the adult into four large tentacles. They continue to live until the generative organs make their appearance in four chambers, arranged round the stomach, when they produce ova and sperm-cells and die. The fertilised egg, however, does not develop into the large organism by which it was produced, but into the little sex-less Hydra-tuba from which its immediate parent was originally detached; while the original polypoid body may still remain, and return to its polype-like condition, and original mode of increasing by gemmation, forming a new colony, and in time becoming the progenitor of a new series of reproductive Medusæ.

We have here a striking example of the so-called alternation of generation, the phenomena of which are among the most extraordinary with which we are acquainted in the whole animal kingdom. The minute, fixed Hydroid polype, in many respects resembling a plant, not more than half-an-inch long, giving rise to the absolutely gigantic free-swimming Medusæ, the ova of which, instead of being developed into the likeness of its parent, revert again to the original, tiny, immovable, plant-like organisms from which they were at first produced.

EXPLANATION OF PLATE XVIII.

Fig. 1.—*Cordylophora lacustris*, showing a polypite and three gonophores, in different stages of growth, the largest containing ova.

,, 2.—*Sertularia pinnata*, showing capsules.

,, 3.—*Syncoryne Sarzii*, with medusiform zooids (*a*) budding from between the tentacles. *b*., Reproductive swimming-bell, detached and free-swimming. *m*., Manubrium.

Fig. 4.—Development of one of the *Lucernarida*:—*a*, Ciliated free-swimming embryo or "planula." *b*, *Hydra-tuba*. *c*, *Hydra-tuba* further developed. *d*, Strobila stage, with the secondary circle of tentacles. *e*, *Hydra-tuba*, in which the fission has proceeded still further, and a large number of the segments have been detached to lead an independent existence. *f*, group of young medusæ of the natural size. *g*, Individual seen from above, showing the bifid lobes of the margin, and the quadrilateral mouth. *h*, Individual viewed sideways, and showing the proboscis.

An Examination of the External Air of Washington.

By J. H. Kidder, M.D., Surgeon U.S.A. Navy.*

Plate 19.

DR. KIDDER has very courteously sent us a copy of this report, consisting of twenty-two closely printed pages and ten Phototype plates.

The first portion of the work treats of the Chemical Analysis of Air, and it may not be uninteresting if we describe the apparatus employed, which is that devised by Dr. Fox, and which brings "continually fresh quantities of air into intimate contact with a small quantity of very pure water, which is reduced to a minute of subdivision by pulverisation."

By referring to Pl. XIX., Fig. 1, it will be seen that the air and water are comminuted by this device probably as finely as possible, and brought into intimate contact with one another. The air can, moreover, be measured with tolerable accuracy, so that there is good reason to expect to find in the water all of the contained solids which are small enough to pass through the jet of the atomiser, and all of the gases and salts which are soluble in water.

* Extracted from the Report of Surgeon-General P. L. Wales, U.S. Navy, for 1880.—Washington : Government Printing Office, 1882.

But it is with the Microscopic examination of the Air that we feel most interested, the materials for which have been obtained in the following different ways :—

1.—Evaporation to dryness of a drop of the fluids resulting from atomisation, and from condensation of moisture upon cold surfaces.

2.—Air-dust collected upon slides and small flattened watch-glass-like discs, by simple exposure within and without doors.

3.—Air-dust collected and retained by a drop of glycerine upon glass slips exposed to the air.

4.—Air-dust collected by the contrivance represented in Fig. 2, Pl. XIX., which consists essentially of a double-winged vane, turning freely upon an agate bearing, and carrying at the end opposed to the wind a glass funnel with its stem bent at right angles. Beneath the end of the funnel, held horizontally by spring clips, is a glass slip, upon which is a drop of glycerine. A moveable weight serves to balance the two ends of the vane, and the upright rod (*a*) can be unscrewed from the tripod foot, and fixed into any wooden surface. For this purpose it terminates in a sharp steel point, not shown in the figure.

The principle of this apparatus is not essentially different from that of the aëroscopes devised by Pouchet, Madox, and Cunningham. In these instruments the funnel has been drawn out to a fine point, so as to impinge upon a thin cover or slip set vertically, and the glycerine with which the latter was covered had a tendency to absorb moisture from the air and run off from the glass after long exposure. By bending the tube of the funnel at right angles this difficulty has been obviated in the apparatus here figured, and some improvement has been made in the details of its construction.

Moisture which had been impregnated with the contents of the air, either by atomisation, condensation upon cold surfaces, or by the natural washing process of rain and snow-falls, when dried upon a glass slip has been found to contain the following substances :—

1.—Epithelium from skin and mucous membranes.

2.—Vegetable epithelium and unrecognised *débris*.

3.—Hairs and threads of various fabrics.

4.—Particles of sand, glass, metals, soot, and starch.

5.—Parts of chitinous shells of small insects.

6.—Bits of feathers, and the pappus bristles of composite plants.

7.—Minute, highly-refracting particles, simulating *micrococcus*.

8.—Crystals of various forms and sizes.

9.—Pollen-spores of many different kinds.

10.—Leaf-hairs.

11.—Mycelium and spores of fungi.

12.—Nucleated cells, resembling leucocytes.

13.—Bacteria, as *bacterium*, *vibrio*, *bacillus*, and *micrococcus;* and under the forms of aggregation known as *zooglœa*, "swarms" *leptothrix*, and *torula*.

When observed fresh, after preservation for a longer or shorter time in well-stoppered glass bottles, the same moisture has contained, besides many of the objects above noted :—

1.—Living algæ.

2.—Amœba, flagellate and ciliate infusoria.

3.—Fungi.

4.—Bacteria of many forms.

Specimens collected by the vane microscope (Fig. 2) and mounted in glycerine abounded in pollen, leaf-hairs, spores of *sphæria*, epithelium, and detritus, both organic and inorganic.

Dust, collected dry, by simple exposure of slips and discs to the air, contained sand, soot, etc., and numerous crystals, mostly rods and radiating needles.

And, finally, the discs and tubes containing collections made in hospital-wards abounded in epithelium, starch-cells, resembling leucocytes, and threads and hairs.

Epithelium, as appears from the foregoing summary, is always and everywhere present in the air. Considering the probability of the communication of contagious exanthemata by this means, the constant presence of epithelium in the air becomes a fact of considerable hygienic importance.

Particles of *glass* are often found upon air-slides, which do not come from the air itself, but from the tube by which the drop

to be examined is transferred to the slide, and which is often allowed to rest on the slide for a time, while the soiled contents of the drop are subsiding. When the glass tubes used for this purpose have been heated to incipient fusion, so that the sharp edges of their orifices are rounded, no particles of glass appear in the specimen.

Entire shells of *acarini* have been not uncommon in the air. Other insect detritus have been mostly scales of lepidoptera and parts of flies and spiders. The pappus bristles of many of the *compositæ*, especially the late flowering asters, are often found in the air; a common form resembles miniature stems of *equisetum*.

The curious pollen of the pine, and the leaf hairs of various plants are among the commonest objects in the air of the early spring. Later in the season the place of these forms is taken by other kinds of pollen—notably, that of several kinds of grass have been recognised.

EXPLANATION OF PLATE XIX.

Fig. 1.—Apparatus separating organic matter from the air:—
A, Glass cylinder, closed by rubber stopper, through which pass *B*, a Richardson's atomiser cut short, and *C*, a glass tube ground as a stopper, into the bottle *D*. Air, forced in by the hand-pump, *E*, atomises the water in *A*, and passes out by the tube *C*, carrying a small portion of the atomised water with it, which is stopped in the bottles *D* and *D'*. In *D* the tubes are ground to fit as stoppers. *D'* is closed by a perforated rubber stopper. *F*, pipette and rubber tube for washing.

,, 2.—Contrivance for collecting dust from the air on a glass slide, described on page 184.

On the Peronosporæ.

By George Norman, M.R.C.S.E.

Plates 20, 21, 22, 23, 24.

First Part.

AMONGST the numerous groups of parasitic fungi that have been investigated by mycologists during recent years, probably none, excepting the Bacteria, have received so much attention as the two closely-allied ones of Saprolegnia and Peronospora. These two groups have not only much in common between themselves, but as regards their development, etc., are so closely connected with the Algæ as to bear out the opinion that has been expressed by some botanists, that the lower Algæ and Fungi pass into one another at one or more points.

The Saprolegnieæ were fully treated of in the last Vol. of this Journal,* and on the present occasion I propose to take up the Peronosporæ in the same manner. The few species of *Peronospora* that were formerly known were at first included in the neighbouring genus, *Botrytis*, but as fresh specimens were discovered, and decided differences were thought to be observed between them and *Botrytis*, a new genus was formed and called *Peronospora*. This genus now contains upwards of forty species. *Peronospora* belongs to the family *Hyphomycetes*, order *Mucedines*, and the following is Cooke's definition of the genus:—"Parasitic, threads mostly inarticulate. Spores of two kinds. Conidia on the tips of the branchlets. Oospores large and globose in the creeping mycelium."

This definition is somewhat vague, and De Bary, who has devoted much attention to this group of fungi, proposes to include a far-removed group, *Cystopus*, or White Rust, with the *Peronospora*, in one genus, and to subdivide them as follows:—

1.—Cystopus. Conidiophores grown in large bunches, conidia being developed in single rows in basipetal order.

2.—Peronospora.—From a tree-like mycelium conidiophores arise, singly or in small bunches at the ends of the branches, and have no successors in the direct line.

* See Vol. II., p. 185.

3.—PHYTOPHTHORA. Differs from the last in its multiple and successive conidia, which, when shed, leave swellings on the branches. This section includes *P. infestans*, the Potato-Fungus.

Although *Peronospora* has become associated in most people's minds with the potato disease, it is well to remember that the potato is only affected by one species of *Peronospora*, and that other species attack nearly all our ordinary vegetables, such as cabbage, cauliflower, spinach, lettuce, turnip, parsnip, pea, tomato, onion, etc., but fortunately with not the same virulence as in the case of the potato.

The general characteristics common to all three divisions are, that the ripe conidia, when placed in water, produce zoospores; which penetrate the plants, and ceasing to move, develop threads, or mycelium. By another, a sexual mode of propagation, the oozonia, after being fertilised by the antheridia, produce from their protoplasm a thick-walled oospore. Mycelial threads sprout from this latter, and the above process is repeated. A considerable period of inactivity may, however, precede the germination of the oospore, which in this case hibernates for the winter, whilst its host decays. The conidia propagate and spread the fungus during the summer, but do not live through the winter.

The *Peronospora*, including *Phytophthora*, form a mycelium which is neither so thick nor so gelatinous as *Cystopus*. The mycelium usually penetrates not only the intercellular passages of the plant which nourishes it, but also perforates the cells themselves, and in some instances produces little protrusions which press against the cell-walls and become fixed, thus resembling in all respects the suckers which are invariably found on the mycelium of *Cystopus*. Long, slender branches of the mycelium emerge into the air through the stomata of the host, at the end of which ellipsoidal conidia are produced. In some cases, these conidia fall off, and at once put out a germinating filament (*e.g.*, *P. gangliformis*, the lettuce Peronospora, and *P. parasitica*, the cabbage and turnip Peronospora.) In other cases, the protoplasm first escapes out of the conidium and forms a roundish cell, which at once puts forth a germinating filament (*e.g.*, *P. pygmæa*, the Anemone Peronospora). But quite a different process occurs with other conidia, which are generally of a larger size than those

previously described. When one of these conidia falls off and reaches moisture, such as a drop of rain or dew, it immediately breaks up into a swarm of from six to fifteen zoospores (*e.g.*, *P. infestans*, the potato fungus, and *P. nivea*, the parsnip Peronospora). These zoospores are little masses of protoplasm furnished with two lash-like tails, by means of which they move about so rapidly that it is difficult to follow their movements in the field of the microscope. In about half-an-hour this swarming process comes to an end, the zoospores become firmly attached to the cuticle of the host, invest themselves with a thin cell-wall, and begin to germinate.

In all these cases, so potent is the mycelium that it is capable of at once corroding, boring, and entering the epidermis of the leaf, thus giving rise to the well-known brown or black spots so characteristic of the fungus. Whilst on this subject, I cannot omit quoting the careful observations of a recent observer, H. Marshall Ward, published in the *Quart. Journ. Micro. Science* of last year. He found that, while the mycelium of the fungus absorbed the protoplasm from the cells of the affected plant, it left the starch-grains in the tubers of the dahlias and potatoes untouched; and he desired to know how it was, that at a late stage in the development of the fungus, the starch-grains, cell-nucleus, and even cell-walls disappear? He came to the conclusion that the remaining changes in the cell-contents are effected by *Bacteria*, carried into the invaded tissues by the hyphæ of the fungus; that these Bacteria reduce the rest of the protoplasm and nucleus, first to a soluble mass, and then cause the dissolution of the starch-grains. At first, the action of the Bacteria is taken advantage of by the fungus, but eventually the mycelium of the latter suffers from the dominance of the former, and becomes in part a prey to its companion, not, however, before it has formed its well-protected oospores, which lie unhurt among the rotting *débris*.

The mention of the oospore brings us back again to the reproductive process in the *Peronospora*. The propagation of the fungus by means of conidia and zoospores is only an asexual process. There is also a sexual propagation, as in the *Saprolegnieæ*. The sexual organs of the Peronospora are developed in the interior of the tissue of their host. Spherically dilated ends of branches of

the mycelium shape themselves into oogonia, in each of which an oosphere is formed out of a portion of the protoplasm. From another branch of the mycelium, a branchlet grows towards the oogonium, swells, and becomes closely attached to it; and the thicker part becoming separated by a septum (just as takes place with the oogonium itself), developes into an antheridium. As soon as the oosphere is formed, a fine branch of the antheridium reaches it, penetrating the membrane of the oogonium. After fertilisation, the oosphere becomes surrounded by a coat, which thickens and forms a rough, dark-brown external covering, or exospore, and an inner endospore. These oospores, which remain dormant throughout the winter and then germinate, are the so-called "resting-spores," and a curious point in connection with this is that the resting spore in some cases attains its full development on a host other than the one on which it is usually found. Thus, the resting-spore of the lettuce Peronospora is more frequently found on common groundsel, or on sow-thistles, than on the lettuce; and De Bary suggests that some member of the order *Scrophulariaceæ* may yet turn out to be a commoner host for the resting-spores of the potato fungus than the potato plant itself. De Bary also suggests that in some cases where the resting-spores are not found, the mycelium of the fungus may become perennial, and thus carry the fungus over the winter by discharging the function of hibernation.

Selected Notes from the Society's Note-Books.

Argulus foliaceus from Stickle-back and other fishes, are not difficult to obtain, as the Stickle-backs found in clayey pools generally possess several. They should be lifted off the fish with a knife, and dropped at once into the mounting medium. Glycerine-jelly, or Dean's gelatine, is preferable to balsam for such delicate

Crustaceæ, for when so mounted they are susceptible to polarised light, or the paraboloid may be used. Few crustaceans, when alive, form more beautiful objects, whether viewed transparent, polarised, or with spot-lens.

THOS. CURTIES.

Caligus rupens is a common parasite on sea-fish, and may often be found on salmon, etc., at the fishmongers. They are popularly known as *Sea-Lice*. The females are furnished with two long strings of ova, which give them a very peculiar appearance.

H. E. FREEMAN.

Acari from Chaffinch.—This mite very much resembles one found in a cheap quality of raw sugar, and is commonly known as the sugar-mite.

E. LOVETT.

By staining this mite, the curious pads which serve as feet would be shown very plainly; otherwise, they are almost invisible.

H. M. J. UNDERHILL.

Eggs of Vapourer-Moth, O. Antiqua, are attached to the cocoon, on which the wingless female, after crawling out of the pupa-case and receiving the male, which is attracted by a sense peculiar to a few species, such as *Carpini*, *Quercus*, etc., deposits her eggs, and then dies.

E. LOVETT.

May I venture to differ from Mr. Lovett on what he says about the Female of the Vapourer-Moth dying after depositing her eggs? Two or three years ago, one of these creatures made her nest in a chink on the outside of one of my windows, and I watched her with interest. She laid several eggs, but all had been hatched, and I had caught several full-grown vapourers to put into my cabinet, whilst she was still alive. I *killed* her, however, because I wanted her to grace my cabinet also, and there she is now.

E. E. JARRETT.

Exuvia of Pupa of Circopides (Frog-Hopper).—A great quantity of these were found on the underside of oak-leaves in Goodnestone Park, in August; sometimes as many as six or seven were found on one leaf. They are attached by a thread or two, probably to assist the insect in extricating itself. I have searched the oaks at Wood Green without finding a single specimen.

H. E. FREEMAN.

Exuvia of Earwig.—I found a great number of these in a sheltered crevice of a garden-wheelbarrow. They were in good condition, are easily mounted, and are extremely interesting.

E. LOVETT.

Foot of Larva of Puss-Moth (Cerura vinula).—These larvæ are common on willow and poplar trees during July and August, and take a firmer hold with their feet than any other larvæ I know. No amount of beating the branches will shake them off the stem.

E. LOVETT.

Winged Atom is one of the smallest insects known; it is one of the *Ichneumonidæ*, and is so small that its larvæ live in the *eggs* of Lepidoptera instead of in the bodies of Caterpillars. I do not know its specific name.

It may, perhaps, interest some to know how it was mounted. I saw several of these creatures, crawling (like moving grains of dust) on a window-pane, and thinking they might be interesting for the microscope, I transferred a few by means of a damp camel's-hair brush to some glass slips. I then put a drop of turpentine on each, and allowed it to soak for one minute; then added diluted balsam, and laid on the cover-glass. Only this one turned out well; the rest went to "squash." The posterior wings are very minute, and may pass unnoticed at first sight. They are close to the base of the anterior wings, and seem almost to join them The antennæ are very large in proportion to the size of the insect. I wonder what is their function in this particular insect. Perhaps the clubbed ends are, like the tips of our fingers, highly sensitive to touch; and for what, then, do they require so delicate a touch? Sight would seem to be the most useful sense for discovering the eggs of Butterflies or Moths.

F. J. ALLEN.

Hairs from Foot, Throat, and Tail of Ornithorhyncus Paradoxus.—The hairs, as well as the animal, are of an extraordinary make, as will be seen by tracing a single hair from the root to the tip. The broad blades terminating some of the hairs are coated with imbricated scales.

The animal is a native of New South Wales, and is called the Water-Mole. It has a mole-like body, about 18 inches long, and a head similar to a duck.

A. NICHOLSON.

The structure of the hair shows, both, that of wool (at the base) and hairs (in the expansion). This form is not peculiar to the *Monotremata*. That of the Gopher, a small animal in the Missisippi Valley, U.S.A., being nearly similar but finer.

E. HUNTER.

Like the beaver and other fur-bearing creatures, the Ornithorhyncus has two kinds of hair: one fine, apparently for warmth; the other coarser and longer. In the specimen may be seen how in this curious animal the fine hair sometimes terminates in the coarse. As in burrowing creatures, the hair has narrow parts, which act as joints, and enables the animal to go backwards in his hole without the hair changing its direction in the skin.

T. INMAN.

Reviews.

A SYNOPSIS OF THE BACTERIA AND YEAST FUNGI and allied species (Schizomycetes and Saccharomycetes). By W. B. Groves, B.A., with 87 Illustrations. (*London: Chatto and Windus*, 1884.)

This work treats of the subject in hand in a very thorough and exhaustive manner.

The first chapter, occupying 56 pages, is devoted to various genera, included in the group *Schizomycetes*, viz.—Micrococcus, Ascococcus, Cohnia, Bacterium, Bacillus, &c., of which altogether 79 species are enumerated, described, and illustrated by 57 figures.

Chapter II. treats of the Saccharomycetes or the Yeast Fungi. This group is composed exclusively of the genus Saccharomyces, and has 12 species.

We have next a chapter on Classification, followed by a description of the Protean or Little-known species, in which are found several of the lesser-known Bacteria, Bacilli, and several others. In all, 133 species of these minute fungi are described, many of them being carefully illustrated. There are three Appendices, viz.—On the unit of Microscopical Measurement, on the staining of "Bacillus Tuberculosus," and on diseases produced by the Schizomycetes, of which we are sorry to find a tolerably long list is possible to be given.

We recommend this book to the notice of all Mycologists, feeling sure that the name of the writer is a sufficient guarantee for the accuracy of its contents.

Messrs. Swan Sonnerschein and Co. have favoured us with a number of their "YOUNG COLLECTOR'S HANDBOOKS."

These, each in a neat wrapper, are published at one penny, and consist of 32 pages of letter-press, interspersed with a number of engravings. They are written by well-known men of science, each being an authority in his own special department.

Those already published are Beetles, Butterflies and Moths, and the Orders of Insects, by W. F. Kirby; British Birds, by R. Bowdler Sharpe; Greek and Roman Coins, by Barclay V. Head; Flowering Plants, by J. Britten; Shells, by B. B. Woodward; and Postage Stamps, by W. T. Ogilvie. These are most decidedly wonders of cheap literature, and we trust that all our young friends will lose no time in procuring copies of them. We are glad to learn that others are in course of publication, and it is promised that the series will be very much extended. The perusal of these Penny Handbooks has afforded us much pleasure.

THE WONDERS OF PLANT-LIFE UNDER THE MICROSCOPE. By Sophie Bledsoe Herrick, 1884. (*London: W. H. Allen and Co.*)

Miss Herrick has put the marvels of Plant-Life in a very agreeable form, and described them in a most interesting manner. The ten chapters into which the work is divided, treat of the Beginning of Life, Single-celled Green Plants, Fungi and Lichens, Liverworts and Mosses, Ferns, Physiology of Plants, Corn and its Congeners, the Microscope among the Flowers, Pitcher Plants, and Insectivorous Plants. The Volume comprises 248 pages, and is illustrated by 85 splendidly executed engravings.

BALDNESS AND GREYNESS, their Etiology, Pathology, and Treatment, by Tom Robinson, M.D. Second Edition, Enlarged and Re-written. (*London: Henry Kimpton.*)

In this work, the Anatomy and Physiology of the Hair receive the Author's first attention, after which, the colour and texture of the hair is discussed; then follows a description of the various diseases to which the hair is subject, with their various treatments. To the microscopist the two first chapters will prove of much interest, for although no plates or illustrations are given, the chapters are so intelligently written, that a large amount of useful information will be gained by their perusal.

Correspondence.

To the Editor of "The Journal of Microscopy and Natural Science."

DEAR SIR,—

Will you allow me to say that I am exceedingly interested in Pond Life, and though I am acquainted with many of its living forms, I occasionally meet with some which are unknown to me? Will any of your readers—with your permission—undertake through the medium of your columns to assist me? If I may further suggest the desirability of having a list of persons willing to help in this way, published in your Journal, I feel sure that some of your readers will be so good as to render valuable assistance of this kind to those who are really anxious to learn.

I am, dear Sir, yours truly,

JNO. R. TIFFEN.

To the Editor of "The Journal of Microscopy and Natural Science."

DEAR SIR,—

I am much interested in your Journal, and feel sure that your readers cannot fail to be pleased with the able manner in which it is conducted. Excuse the suggestion, but now that it is so well known and circulated, it appears to me very desirable that it should become the acknowledged and generally adopted Journal of the Microscopical Societies in general. A means of complete and satisfactory intercommunication of this kind is very much needed. How do matters really stand now as regards Microscopy? There is the "Royal Microscopical Society's Journal," but this, through want of space, frequently avoids recording the doings of provincial and other societies. In plain, sober truth, there is at present no recognised organ in which the various Papers and other matters of interest can be recorded. Why not carry out thoroughly the work you have begun so well? I would venture to suggest that no time should be lost in making your Journal the medium, not only of publishing Papers read, but also of giving regular accounts of any matters of interest that may transpire at the various and numerous meetings of Microscopical Societies throughout the country. At present each society seems to have an isolated and separate existence, and to be living a sort of detached life, when each and all should be working together as a harmonious whole, and helping and encouraging each other in their common object. I submit that this can only be attained by

means of a properly accredited and admittedly representative Journal. Why not let yours hold this position?

I am, dear Sir, yours faithfully,

A PRESIDENT.

To the Editor of "The Journal of Microscopy and Natural Science."

MY DEAR SIR,—

I send you a pamphlet of mine, read last year at the Royal Society, Victoria, on Bacilli in Living Plants, to which subject I shall be glad if you will draw attention. Also I enclose a paper of mine lately read to our Society, but which is not likely to see print for some time, and if you like to utilise it in part, or wholly, you are welcome. The subject, I believe, is quite new, and I think may lead to interesting inquiry, and shall be glad to have it set on foot among your country members, who, I should imagine, would be able during the foliage season of England to experiment in the same direction; but I am desirous of obtaining opinions on this subject, and when you notice any, please let me know where to look for them. If you could direct attention to it by Sachs in Germany, I shall take it as a favour, for I am very much interested in the process, and he is a likely man to mete out its worth. I suppose I may be able to carry on the investigation, but time is required, and if more is forthcoming I will let you have it, if approved of.

Hoping you are well and prospering,

I remain yours sincerely,

Melbourne. THOMAS SHEARMAN RALPH.

[We hope to publish the other paper alluded to by Dr. Ralph in our next.—ED.]

Current Notices and Memoranda.

Mr. Chas. V. Smith, of Carmarthen, has sent us his Classified Catalogue of very valuable and instructive slides, illustrating the Structure, Growth, and Reproduction of Plants.

THE SCIENCE MONTHLY keeps up its character for first-class articles. The "Leader of Science," whose portrait is selected for

the June part, is Mr. Herbert Spencer. The illustrations are excellent; Vol. I. is completed with the present part. In July, we understand that "Science Monthly" will be permanently doubled, both in size and price.

THE NATURALIST'S WORLD AND SCIENTIFIC RECORD, has also been enlarged from 16 to 20 pages, without an increase in price. We are glad to see this, and to notice that the interesting character of its articles is well sustained.

COTTON, WOOL, AND IRON: The Boston Journal of Commerce. (*Boston, U.S.A.*)

This is the most readable of all the trade Journals it has been our fortune to meet with. The Microscope, in its Editor's hands, finds constant employment, and appears to do good work in the detection of adulteration in the various fibres. A long article is devoted in the last copy received, to the detection of the "Oil-pocket" in the fibre of cotton.

We have mounted a great number of the specimens prepared by Mons. S. Louis (France), and sold by Mr. Wm. West, of Bradford, and find them well prepared, abundantly supplied, and that they make very excellent Slides.

Each series is supplied in a neat wood box, the Diatoms, Algæ, and many other objects, being in separate glass tubes. Directions for mounting will be found in each box.

MESSRS. SINEL & CO.'S UNMOUNTED MARINE OBJECTS.

A correspondent writes us that he obtained a tube of the following Marine organisms, viz:—*Porcellana longicornis*, *Hippolyte varians*, *Nebalia bipes*, *Asteria gibbosa*, *Ophiocoma neglecta*, and *Gammarus marinus*.

When mounted in cells, with preservative media, some very beautiful results were obtained, particularly when the spot-lens and 2-inch objective were used.

EXCHANGE.—Wanted, Diatoms, on Algæ or in mud, from all the tropical seas. Will give in exchange a large quantity of fine selected diatoms, or other slides, or cash.

J. C. RINNBÖCK,

14, Simmering, Wien, Austria.

THE JOURNAL OF MICROSCOPY

AND

NATURAL SCIENCE:

THE JOURNAL OF

THE POSTAL MICROSCOPICAL SOCIETY.

OCTOBER, 1884.

On the Peronosporæ.

BY GEORGE NORMAN, M.R.C.S.E.

Plates 20, 21, 22, 23, 24.

SECOND PART.

HAVING given a general account of the life-history of the Peronosporæ, we can now proceed to examine some of the more striking members of the genus, beginning with those least known, and reserving the potato fungus to the last.

P. GANGLIFORMIS, the Lettuce Peronospora.

Threads of the mycelium stout, now and then torulose; suckers vesicular, obovate, or clavate; fertile threads, 2—6 times dichotomous, sometimes trichotomous; stems and primary branches slender, dilated or inflated above; the ultimate ramuli inflated at the apex into a turbinate or sub-globose vesicle, bearing from 2—8 spicules;

acrospores minute, sub-globose; apices with broad, depressed papillæ, produced in the spicular processes. Oospores small, globose, and of a yellowish tawny colour. I quote the following from Mr. Worthington Smith, in the *Gardener's Chronicle* for Nov., 1883:—"As too often happens with names of fungi, various botanists have, with insufficient reason, altered the name of the Lettuce fungus. Corda was the first to do this, and he changed *Botrytis* to *Peronospora*, and since then the fungus has been generally known as *P. ganglioniformis*. De Bary did not approve of 'ganglioniformis,' so altered it to 'gangliformis.' Then Tulasne re-named the fungus *P. parasitica*, var. *lastucæ*. And lastly we observe that Dr. Max Cornu prefers *P. gangliiformis*." We have recently seen it suggested that a society should be formed for the purpose of taking back Cleopatra's Needle and other Egyptian and Grecian antiquities now in Europe, to Egypt and Greece. Perhaps the time may some day arrive when a society will be formed for the reconstitution of old generic names and the obliteration of many worthless new ones. *Botrytis* is a far better name than *Peronospora*, for the former means a bunch of grapes, and refers to the appearance of the fungi as they hang down from the under-surface of leaves very much in the style of bunches of grapes. *Ganglioniformis* refers to the fruiting-threads of the fungus, resembling the natural enlargements, termed ganglions, in the course of a nerve. Berkeley pointed out in the first volume of the *Journal of the Royal Horticultural Society*, in 1846, that lettuces were at that time subject to a putrefactive disease, caused by a fungus closely allied to the fungus of the potato disease, and named by him *Bot. ganglioniformis*. He described the fungus as common in the spring; but it appears that there are two crops of this fungus every year; and that the most virulent is generally in September or October. The invasion of lettuces in the late autumn is often so destructive that it entirely destroys the harvest of lettuce seeds.

The ganglion-like swellings of the branches are a peculiar feature of this fungus. The end of each fine ultimate branch is most beautifully dilated into a saucer-like expansion, with a single excessively-attenuated spicule growing from the centre of each saucer, and from three to five spicules round its margin. Each spicule is

slightly dilated at the tip, and on each tip a comparatively large globose spore is balanced. The mycelium within the leaf is furnished with minute suckers, with which the fungus pierces the cells and supports its life. The mycelial threads are too large to get through the minute stomata of the leaf. To meet this difficulty, the threads inside the leaf, as they approach the stomata, twist round once like a corkscrew, flatten themselves, and push through the stomata with a chisel edge. As soon as this chisel edge is pushed into the air, a septum appears, and from this septum one, two, or three fruiting-threads arise.

Happily, the Lettuce Peronospora is not everywhere in Britain. It is recorded as growing on sow-thistles in Scotland. Some market-gardeners have never seen it; others know its spring and autumn visitations too well. It causes large pallid patches to appear on the leaves, and on the outside of these patches, little white nodules of the destructive mould may be seen. In the spring the pest begins on the outside leaves, and proceeds inwards, carrying putrefaction in its course. In bad cases, summer lettuces are quickly reduced to lumps of wet putridity. This fungus grows on other Composite plants, both wild and cultivated, such as endive, groundsel, nipplewort, and sow-thistles. Weeds nurse the fungus for the lettuces, and as *P. ganglioniformis* is known to produce resting-spores, it is desirable that all decaying lettuce material, as well as the decaying weeds above mentioned, should when possible be gathered and burnt.

P. Parasitica. Cabbage Peronospora.

Threads of the mycelium thickened and much branched; suckers numerous and branched; branches clavate, obtuse; fertile threads thick, soft, flexile, equal or unequal; five to eight times dichotomous, rarely trichotomous, branches always repeatedly trifurcate; acrospores broadly elliptical, very obtuse at the apex, white. This fungus invades cabbages, turnips, and other cruciferous plants, as shepherd's purse. Cauliflowers are sometimes attacked by this fungus. Yellow spots appear on the upper surface of the lower leaves, which, when examined on the lower surface, are found glaucous with the mould, which usually soon destroys the whole plant. In turnips the leaves seem to be first attacked; then the root itself becomes covered with waved, irregular lines,

following the course of the vessels, around which spots are formed by the deposition of dark granules, in the same manner as in the potato. In the resulting rotten condition of the turnip, numerous resting-spores may often be found. These resting-spores were first observed by Mr. Broome, of Batheaston, who sent them to Dr. Montague, who made a drawing of them.

P. Viticola. The Grape Peronospora.

This fungus has not been observed in Britain, but as it is well-known in America and latterly in France, a description is here given. The mycelium is narrow, often constricted and varicose, no suckers; conidia threads stipitate, emerging in bundles from the stomata, often dichotomous, and branches trifurcate. Acrospores small, ovoid, and hyaline; oospores small and hyaline. In 1880, early in October, the vines in some of the French vineyards presented a very unusual appearance. They were covered with dry, brown, shrivelled leaves, as if they had been burnt by the sun or frost-bitten, and at the extremity of the branches a few small, new leaves were visible, showing a very backward condition of growth. In places where the leaves were less diseased, dry brown spots were visible, which spread at the expense of the living tissue, ran together, and covered the whole leaf. When these prematurely-dried leaves were examined, the underside was seen to be covered with the white efflorescence of a mould, which by-and-bye changed to a dull, leaden colour, slightly ruddy, and proved to be *P. viticola.*

The disease had long been known in America, and as long ago as 1877 Max Cornu called attention to the fact that the introduction of American stocks into French vineyards might introduce a disease very much to be dreaded. In 1878 it was recognised on an American vine stock, in the south-west of France; in 1879 it had reached the Rhone valley; and in 1880 it was found, as above mentioned, at the north-western extremity of the culture of vines in France, so that it had undoubtedly spread all over the country. The question then arose as to how far this new enemy was to be dreaded. According to American experience, the damage occasioned by it is quite different, according to climate. In Missouri the mildew sometimes destroys two-thirds of the crop, but in that hot climate the fungus makes its appearance between the 1st

and 15th of June. In Massachusetts, on the contrary, it does not show itself except in the autumn, and causes scarcely any hurt to the vines. The following is Prof. Farlow's account of it:—"It might naturally be supposed that a fungus so common as *P. viticola*, and so often found on all the leaves of the vine, must have very disastrous effects on the crop. This is, however, not the case. The fungus does not attack the grapes themselves. Besides, at least in New England, it does not make its appearance before August 1st, and the leaves do not look brown until the month of September. As regards the culture of vines in the open air in the northern states, we are disposed to think there is little to fear from the Peronospora, but that, on the contrary, this fungus may be even beneficial. Our indigenous vines are very luxuriant, and possess an abundance of leaves. That which is most to be feared is, that in our short summers the grapes will not be sufficiently exposed to the sun. The *Peronospora* arrives, we think, at a time when the vines have attained their full growth, and when the important point is, that the grapes covered by the leaves should ripen. In drying up the leaves, the *Peronospora* allows the sun's rays to reach the grapes, and it does not seem to injure the vines, which appear to grow on as usual." It is hoped that it may be the same in Europe.

P. SCHLEIDENIANA. Onion Peronospora.

Fertile threads robust, erect, not septate, branched alternately; ultimate ramuli forked; acrospores seated on tips of ultimate ramuli, obovoid or nearly pear-shaped, attenuated at the base, membrane of a dirty violet colour. The individual threads are distinct, but form large patches on the leaves, or even entirely cover them. This fungus is easily distinguished by the peculiar shape of the acrospores. It is not confined to the onion, but appears also on other allied species of *Allium*. It is very common and destructive some years, preventing the plants which are attacked from coming to perfection. It was described in the *Gardener's Chronicle* for 1850 as causing great destruction amongst the onions in Bath and the neighbourhood during that year. Berkeley described this fungus in the *Annals of Natural History* under the name of *Botrytis destructor*.

P. VICEÆ. Pea Peronospora.

Fertile threads densely cœspitose, erect, equal, six to eight times dichotomous; ultimate rumuli shortly subulate, acute; acrospores ellipsoid, very obtuse at apex; membrane violaceous. The under-surface of the leaves of peas and also of tares is liable to attack from this fungus, and in 1846 it appeared amongst vetches in some districts to such an extent as at one time to threaten the destruction of the crops; but a succession of dry weather at once abridged its power and limited its mischief. Mouldy vetches and mouldy peas, evils well known to the agriculturist in damp seasons, are due to this fungus.

P. TRIFOLIUM. Described by De Bary, attacks trefoil and allied plants, and was found by Cooke plentifully on lucerne in some localities.

P. NIVEA. Parsnip Peronospora.

Threads of mycelium stout, often torulose; suckers numerous, vesicular, obovate; fertile threads fasciculate, dwarfish, tapering, or subulate, or once or twice shortly bifurcate, rarely trifurcate, with one to four horizontal branches near the summit; once, twice, or three times bifurcate; acrospores subglobose or ovoid, with an obtuse papilla at the apex.

The plants infested with this parasite are first attacked in the leaves, but afterwards the roots become spotted and diseased, in a similar manner to the potato tubers attacked by the potato fungus. It is found on many umbelliferous plants; hence the name given to it by De Bary of *P. umbelliferarum*. Its attacks on the parsnips are, however, most to be deplored, from an economic point of view.

P. EFFUSA. Spinach Peronospora.

Fertile threads fasciculate, short, thick, two to six times dichotomous above; acrospores broadly ellipsoid, membrane with a violaceous tint. Oogonia irregular and variable in size. This fungus affects the under-surface of the leaves of spinach, goosefoot, knot-grass, etc. It forms effused spots two to six lines broad, generally rendering the leaf yellow. Beds of spinach are sometimes utterly destroyed by this fungus. It was figured by Sowerby in his *British Fungi* some fifty years ago.

Besides being so destructive to plants used as food, this fungus causes equal havoc amongst flowers of certain descriptions. Thus, in the *Gardener's Chronicle* for 1862, Berkeley describes the effect of *P. sparsa* on roses in the following way:—"A quantity of potted rose-plants in a cool house suddenly began to fail, and in a short time every plant died. Irregular pale brownish spots appeared on the upper surface of the leaves, which soon withered and shrivelled up, and ultimately the whole plant was sacrificed. The zoospores were observed moving about with great rapidity by means of lash-like threads." And again, in April, 1863, he describes the fungus as attacking between 3,000 and 4,000 roses in one garden. As the fungus burrows amongst the tissues of the leaves, it cannot be destroyed except by destroying the leaf.

The red corn-poppy is attacked by *P. arborescens*, the wood anemone by *P. pygmæa*, the veronica by *P. grisea*, the sandwort by *P. arenariæ*, the ranunculus by *P. ficariæ*, the Rhinanthus by *P. densa*, the lamium by *P. lamii*, and so forth.

There are now about forty-five described species of *Peronospora*, and when we consider that each of these probably possesses the triple mode of reproduction already described, the conclusion is irresistibly forced upon us, that this genus of fungus is almost unparallelled in the amount of damage it is capable of inflicting on the vegetable kingdom.

P. INFESTANS, Potato Peronospora.

Threads of mycelium slender, always destitute of suckers; pestile threads thin, gradually attenuated upwards, with one to five branches, one or more inflated vesicles near the apices of the branches; branches either simple or with short branchlets; acrospores ellipsoid or ovoid; apex furnished with a prominent papilla.—(Cooke).

Besides producing the well-known Potato disease, this species also attacks the Tomato, the leaves of which become greatly spotted, the stems partially blackened, and in some cases the young green fruit is rotted, the fungus penetrating the rind of the fruit direct from the outside. The *Gardener's Chronicle* contains the record of a serious outbreak of this disease amongst the Tomatoes at Bath, in the year 1852.

We now have to examine the next important member of the genus—the *Peronospora infestans*—or Potato fungus proper, there being really more than half a dozen fungi which affect the Potato; but none of them equal to this one in importance. The Potato fungus was not included in the collections of De Candolle or Sowerby. The first published description of the fungus was by Dr. Montague, which appeared in *L'Institut*, for September, 1845. In November of the same year Payen published an account in *Ann. Soc. Hort. de Paris*, and Berkeley's article appeared in the *Journ. Hort. Society*. In December of the same year, Morren published an account of the fungus in the *Ann. d'Agriculture*. To Berkeley, then, in this country at least, belongs the honour of having first assigned a fungoid origin to the Potato disease, and still more honour is due to him for having held to the opinion when others wavered. We find him writing regarding the fungoid origin of the Potato disease in the *Gardener's Chronicle* for 1846, as follows:—"We come now to the theory which has been so much canvassed, and which is now peculiar almost to Dr. Warren. Of this opinion, notwithstanding the opposition, and in some instances the ridicule, almost, with which it has been assailed, I must profess myself at present." He goes on to say that the decay is the consequence of the presence of the mould, which feeds upon the juices, and prevents the elaboration of nutritive sap in the leaves.

The first onset of the disease in this country was alarming enough. Appearing first in the Isle of Wight in the autumn of 1845, it rapidly spread through the South of England. Early in September it appeared in Ireland, and shortly afterwards in Scotland.

Berkeley's still classical description may be read in the *Journ. Hort. Soc.*, or in a more accessible book—"Cooke's Microscopic Fungi." Berkeley clearly established that the disease was due to a fungus, which penetrated by means of its fine mycelium the tissues of the plant, eventually reaching the tubers and involving the whole in a common destruction. It protruded branches through the stomata, which bore two kinds of spores, one of which set free a number of locomotive bodies, capable of propelling themselves through the water by whip-lash-like filaments. Berkeley observed these bodies, but did not detect their cilia,

which were first pointed out by De Bary, in 1868. At this point the knowledge of the life-history of the Potato disease stood stationary for many years. Other Peronosporæ had been found to possess another mode of reproduction, viz., a sexual one, the product of which was a spore possessing greater powers of remaining in a dormant, or resting state, than the other kind of spores. No such resting spores had been found in *P. infestans*, although Montague had met with some bodies which he described under the name of *Artotrogus*, and which had been suggested by some botanists, including Berkeley, as likely to be the missing organs.

In 1873, owing to the widespread ravages of the fungus, the Council of the Royal Agricultural Society, through the kindness of Lord Cathcart, offered a prize of £100 for the best essay on the Potato disease, but although ninety-four essays were sent in, not one was deemed worthy of the prize. It is hardly necessary to say that the leading mycologists in this country held aloof from this form of competition. The next step was one which elicited a great deal of ridicule at the time, and met with an equal want of success, for the £100 prize was now offered for potatoes which would be disease proof. In the next year the Council changed their tactics, and recommended that a grant of £100 should be made to some competent mycologist to investigate the life-history of the fungus. In selecting De Bary of Strasburg for this distinction, a grave slight was put upon the English mycologists, for although De Bary was well known for his painstaking investigations, such men as Berkeley, Cooke, and Broome, especially Berkeley, had an European reputation for mycological research.

In July, 1875, Worthington Smith, who had been devoting much attention to the Potato disease, announced that he believed he had discovered the missing link in the life-history of the fungus, viz., the resting spore. Whilst keeping diseased leaves, stems, and tubers of Potatoes in a state of continual moisture under glass, till they were in a thoroughly decomposed condition, he observed certain bodies which he considered must be the antheridia and oogonia of the fungus, and after a little time he found certain dark coloured, warty bodies, which he thought must be the perfected resting spores. Comparing these with the bodies

described as *Artotrogus*, found by Montague in spent potatoes, he considered the two to be identical.

Early in 1876 De Bary's investigations were made known. He also found certain bodies like oospores in decayed Potato tubers, but considered them as belonging to the genus *Pythium*, especially as he was able to grow fresh crops of mycelium from them on the legs of dead flies, bodies of mites, etc. He called the species *P. vexans*, in consideration of the trouble it had given him, and thought that the *Artotrogus* of Montague belonged to a still undetermined fungus. He considered that the perennial mycelium of the Potato disease occasionally discharged the function of hibernation, when the oospores were not found. In this case the spawn of the Potato fungus would live through the winter in the tubers of the Potato, and be propagated in the spring by means of diseased tubers, and of tubers healthy at time of planting, but destined soon to become diseased from others. He thinks there are two methods by which the conidia may pass from the tuber to the haulm. 1.—The conidia may be formed in the tuber, and carried up to the foliage in course of growth. 2.—The mycelium may grow from the tubers up through the haulm and foliage, and there produce conidia. De Bary seemed to think that the fungus found some resting place external to, and independent of the Potato plant, an arrangement by no means uncommon amongst fungi. He suggested the Nat. Ord. SCROPHULACIACEÆ as the place where the resting spores might be found, an idea derived from English botanists. The Secretary of the Royal Agricultural Society had suggested also that Clover or Straw might be the host in question.

In July, 1876, Worthington Smith published a further series of observations. He had, with untiring energy, kept alive and constantly under observation, the bodies he discovered in July, 1875. The only change he noticed for a long time was that they increased in size, till they became nearly four times their original bulk, but at the beginning of May he began to see signs of germination. At this time many of the oospores proved effete, but in some the contents were broken up into zoospores, which were discharged in an active condition, and after swarming became quiescent, and emitted filaments of mycelium. In some

cases the oospores, instead of producing zoospores, produced a thick jointed thread, resembling the threads of *P. infestans*, and in both cases the mycelium produced conidiophores and small conidia, which were believed to be those of *P. infestans*.

De Bary had remarked that supposing the warty bodies seen by Worthington Smith were the resting spores, they could not play an important part in the life-history of the plant on account of their extraordinary rarity. Worthington Smith now points out that in his first experiments the resting spores were certainly rare, but that afterwards they were produced in myriads, and that within the tissues of a comparatively few leaves. De Bary had also further objected that the fungus he had called *Pythium vexans* would grow freely on the bodies of mites, etc., and that *Peronospora* would not do so. Smith says he has observed the *Peronospora* on the bodies of aphides—not only the threads, but also oogonia and antheridia in conjugation. Worthington Smith's experiments were repeated by Messrs. Broome, Vize, and Plowright, with generally satisfactory results in confirming the original experiments. Mr. Plowright observed resting-spores enclosed in the coils of spiral vessels.

Curiously enough, a drawing of the Potato fungus was made in 1845 by G. H. O. Stephens, of Bristol, and in it a body of the exact shape, size, and colour of the resting spore is depicted. He drew what he saw under the microscope, but did not know its import. A copy of this drawing is given in the *Gardener's Chronicle* for 1877. In 1880, Worthington Smith writes as to the non-rarity of the resting spores :—" They exist in uncountable numbers in nearly every old exhausted Potato tuber belonging to infected plants, and may be found most easily in any infected Potato field in this country. Also, that although the mycelium of nearly every fungus is able to go into a state of hibernation at times, according to his experience it is very rarely found in the Potato disease. Controversy, however, with regard to the Potato disease seems never likely to come to an end, for the battle is now shifted to other points."

Berkeley long ago wrote as to the concluding stage of this disease :—" The whole soon dries up, and in many instances exhibits in the centre the black, irregular, fungoid masses which

are known under the name of *Sclerotium vasium*, and which are believed to be the mycelium of certain moulds in a high state of condensation." Worthington Smith, in the *Gardener's Chronicle* for 1880, described and illustrated a *Sclerotium* affecting Potato stems, which he thought belonged to some fungus other than Peronospora. In September, 1883, Mr. Stephen Wilson announced that these Sclerotia belong to *Peziza postuma*, and that he has grown the specimens of the fungus, which he figures, from Sclerotia kept and preserved by him. He queries whether these are truly parasitic, or whether they do not merely follow the decay of the stalks consequent on the common disease. The same gentleman, in the previous year, had made a communication to the Linnæan Society on the subject of certain dark, small, ovoid bodies, found in the leaf of the Potato, and which he considered to be parasitic sclerotia of *Peronospora infestans.* He thought that they were amorphous particles of glutinous plasm, which after a period of incubation germinate in the tissues of the plant, and account for the appearance of disease independently of the conidia. Mr. Murray and Dr. Flight, of the British Museum, had, however, examined them, and submitted them to chemical analysis, and came to the conclusion that they were masses of oxalate of lime, and had no necessary connection with the Potato fungus.

But leaving this subject, there are one or two points of interest to be dealt with. First of all, when did the *Peronospora* first make its appearance? We owe to Mr. Carruthers, of the British Museum, a fossil slide, which has been described by Worthington Smith as probably a fossil *Peronospora.* Silicified mycelia have been known for a long time occurring in fossil wood and ferns, but no perfect fruit had been observed on any fossil mycelium. No description, except that of a Mucor from the Coal Measures, has hitherto been published of any well defined fungus belonging to the Palæozoic series of rocks. This fungus was found in the scalariform axis of a stem of a *Lepidodendron* from the Coal Measures. The mycelium is furnished with numerous septa, a characteristic supposed to distinguish *Peronospora* from *Pythium* or *Saprolegnia*, and the oogonia do not agree with those of *Cystopus.* The oogonia and zoospores are not only of the same

character as those of *Peronospora*, but were, when measured, to the ten-thousandth of an inch, exactly the same in size; the average number of zoospores in each oogonium is also the same. Smith proposes to call this fungus *Peronosporites antiquarius*, and says we have probably in this specimen one of the simple primordial plants of the great family of fungi.

The Potato murrain was not heard of till 1843, but two years later it had become general in Europe and America; it seems as if the Potato fungus had previously attacked some other plant, possibly another species of the genus Solanum, but had at that time found a more suitable nidus for its development in the moist and weakened tissues of the cultivated Potato. Professor Church says:—"The native country of the unimproved Potato (Chili and Peru) differs so greatly as to rainfall and other elements of climate and season from Great Britain, that it is not wonderful to find the plant much altered in character by its long cultivation here. Naturally the plant is almost Alpine in its habits, very aromatic, and less watery than the improved varieties which it has yielded in Europe; and the changes which have been wrought in its nature have rendered it more amenable to the attacks of fungi." The Potato, like all other living things, has a peculiar vitality or vital force, by means of which, if unimpaired, it is capable of resisting disease and of braving the attacks of parasites. But if the vitality decreases, then the Potato becomes liable to disease and to suffer from parasites. This reduction of vital force does not take place suddenly, but comes on slowly, after years of artificial cultivation. The vital force having been thus lowered, if an unusually unfavourable season occurs, the Potato has not enough constitutional energy to resist disease.

When once disease has been experienced, the vitality of the plant is still more lowered, and will continue to be so. As the disease is known in the native country of the Potato, it has been suggested by Mr. Worthington Smith, and others, that the resting spore may have been introduced into Europe in the guano brought from Peru and the Chincha Islands. It has also been suggested that the old disease, called the Curl, amongst Potatoes, is identical with the fungus disease; if so, the *Peronospora* would have been present in Europe many years longer than is supposed at present.

Experience of the operations of the disease in past years has generally shown that when one section of the Potato crop is hardly hit, another as often escapes almost altogether. In average seasons the disease has made its deadly effects most felt amongst the mid-season kinds, whilst early and late ones have suffered less. At other times the fungus has made an early appearance, and has spared the later kinds, thus maintaining a sort of equilibrium, so that an entire loss of crop has not often resulted. In noticing this somewhat curious feature in the disease, we are brought face to face with what is an undoubted problem in connection with its operations, viz.—that the fungus seldom attacks any kind until it has attained to a certain stage of maturity. Whilst matured kinds may be almost destroyed by the fungus, the foliage of later sorts, growing side by side with them, are untouched. There is, further, the interesting fact that the worst phase of the disease attack is generally condensed within a few weeks' space, from which it may be assumed that the active germs of the fungus are operative only during a certain period of time, the weather being probably the guiding instrument as to the fixing of this particular period. A few days of cold rain, with low temperature, or a period of excessively hot sunny days, accompanied by heavy dews and white mists at night, with occasional thunderstorms, may prove most disastrous, broad breadths of luxuriant Potato foliage being reduced in a few days to a blackened and putrid mass.

In conclusion, I give the following practical suggestions which were drawn up some time ago for a Hereford Agricultural Society:—
1.—Burn the haulm, and all waste Potatoes, etc. Do not throw them on the manure heap, because the mildew seeds will gain in strength by resting in the manure, and this manure will help to spread the Potato disease next season. 2.—Boil for a long time all diseased Potatoes before feeding animals with them. It is highly probable that the mildew seeds gain strength by passing through the stomach of an animal, and the manure of animals would thus become a powerful means of spreading the disease. 3.—Do not grow Potatoes on the same piece of land two years in succession. Any mildew seeds (resting spores) which may rest in the ground from last year's crop will begin to grow about the middle of May, but will probably perish if they cannot find

Potato plants as hosts to nurse them. 4.—Be sure the seed Potatoes are free from disease when planted, as a few diseased plants will infect acres of Potatoes in a wet, warm season. 5.—Chemical manures are preferable to other manures, being less likely to contain mildew seeds. 6.—Potato crops may sometimes be saved by pulling up the haulm directly the disease spots appear on the leaves of any one plant.

Want of space has prevented more than just alluding here to the interesting experiments of Mr. Murray, who, by placing glass slips covered with glycerine on the lee side of a field of diseased potatoes, obtained numerous spores of *Peronospora Infestans*, demonstrated the important part the atmosphere has in distributing the summer seeds of the disease. When scientific witnesses speak of millions of spores being found in each diseased plant, which may thus be wafted about in the air; and when they are of opinion that even birds and ground game may be the means of carrying the infection from one place to another, we see the impossibility of ever being able to root out the disease. Attention to the details of scientific cultivation, the choice of new and strong varieties of tubers for seed, and the gradual restoration of a stronger constitution to the Potato by this means, is the direction in which we must look for future success.

EXPLANATION OF PLATES XX., XXI., XXII., XXIII., XXIV.

PLATE XX.—Peronospora infestans.

Fig. 1.—(× 150) Mycelium and branched conidiophore, taken from the surface of a slice of diseased Potato which had been exposed to damp air. *c.*, Young conidia.

" 2.—(× 390) Fragment of a branched conidiophore, like the preceding, but older, having produced conidia, and showing numerous partitions.

" 3.—(× 390) Ripe conidia.

" 4.—(× 390) Conidia putting out germ tubes.

" 5.—(× 390) Thin fragment taken by a vertical cutting from a slice of Potato, the surface (*s.s.*) of which has been sown with spores of *P. infestans*. Two germs have perforated the partitions of the superficial cells of the slice; one has entered the intercellular meatus of the subjacent parenchyma, the other has not yet quitted the cavity of the superficial cell.

PLATE XXI.—Peronospora infestans (× 390).

Fig. 1.—Conidia-zoosporangia sown in water. Protoplasm divided.

,, 2.—Zoospore, free and active.

,, 3.—Zoospores at rest and commencing to germinate.

,, 4.—Zoospores, with long germs.

,, 5.—Epidermis from a stem of *Solanum tuberosum*, in which three zoospores of the parasite have thrust out germs whilst perforating the walls. The parts of the germs outside the epidermis are empty, the penetrating extremity having received all the protoplasm. About eighteen hours after sowing the spores.

,, 6 and 7.—Fragments of horizontal cuttings of the epidermis and cortical tissue of *S. tuberosum*. The germs have penetrated the epidermic cellules; they are branched, and that which is represented in Fig. 7 is beginning to perforate the interior wall of the cellule which encloses it. About seventeen hours after sowing the spores.

,, 8.—Vertical cutting of the same stem which has supplied Figs. 6 and 7, made twenty-four hours later, showing progress of the germ through a large cellule into the lengthened cellules of the cortical collenchyma (*c.c.*).

,, 9 and 10.—Vertical cuttings of leaf of *S. tuberosum*, five days after sowing the spores. *e.s.*, Epidermis of upper surface. *e.c.*, Epidermis of lower surface. The filaments of the mycelium grow between the cellules of the parenchyma, which still appear healthy. In Fig. 10 a conidiophore is emitted from a stomata (*s*).

PLATE XXII.

Figs. 1—4, Peronospora parasitica (× 390).

Fig. 1.—Fragment of vertical section of pith of *Capsella Bursa-pastoris*. A tube of intercellular mycelium thrusts a large dichotomous sucker into one of the cellules. The mycelium carries an oogonium nearly ripe.

,, 2 and 3.—Advanced stages of ripened oogonium. *a.*, antheridium.

,, 4.—Germinating conidium.

Figs. 5—8, Peronospora ganglioniformis.

,, 5.—Ripe conidia.

,, 6.—Germinating conidia.

,, 7 and 8.—Epidermis from leaf of *Lactuca sativa*, conidia of parasite having been sown in it three days previously. The membranes of the conidia are empty, and folded above the epidermis; the germs swollen with protoplasm penetrating the cellules.

PLATE XXIII.—PERONOSPORA NIVEA *(Umbelliferarum)*.

Fig. 1.—Ripe conidia.

,, 2 and 3.—Formation of zoospores.

,, 2—*a*. Protoplasm divided, conidia swollen, terminal papilla not seen; *b*.—Protoplasm withdrawn from wall of cell.

,, 3—*a*. Sporangium enclosing fully developed zoospores; *b*.—Expulsion of zoospores.

,, 4.—Zoospores free and active.

,, 5.—Germinating zoospores.

,, 6—11.—Fragment of epidermis of under surface of leaf of *Œgopodium podagrasia*, showing germination of zoospores, and penetration of the germs in the stomata. Figs. 6—9.—Six hours after sowing the spores. Figs. 10 and 11.—Twenty-four hours after sowing the spores.

,, 6.—Zoospore fixed on a stomata.

,, 7.—Zoospore, with germ entering stomata.

,, 8.—Globular swelling of the germ inside the stomata.

,, 9.—Membrane of spore outside the stoma is empty, and only attached by a very small filament to the germ, which is drawn out in a tube towards a cellule of the epidermis.

,, 10.—Germs which have entered by the stomata, thrusting their extremities into the epidermic cellules, and there developing suckers.

,, 11.—A germ like the two preceding, showing the empty membrane of the spore outside the stomata.

,, 12 and 13.—Slices of epidermis of lower surface of leaf, showing cut stomata by which germs of parasite have entered. Fig. 12 corresponds to Fig. 9, Fig. 13 to Figs. 10 and 11.

,, 14.—Fragment of thin slice of leaf of *Œgopodium*, with a tube of mycelium emitting suckers into the cellules of the epidermis.

,, 15.—Tube of isolated mycelium carrying two oogonia. One is the sessile attached to *b*, and nearly ripe; *a* is the antheridium; the other is perfectly ripe.

PLATE XXIV.—PERONOSPORA ALSINEARUM.

Development of oogonia and antheridia, × 400. *a.*, antheridium; *o.*, oogonium; *m.*, mycelium.

Fig. 1.—Mycelium bearing young oogonium.

,, 2.—Formation of antheridium.

,, 3.—Oogonium separated by a partition from the mycelium tube.

,, 4.—Fully developed antheridium.

Fig. 5.—Antheridium penetrating oogonium and commencing formation of gonosphere (*g*).
,, 6.—Fecundation of gonosphere by antheridium.
,, 7.—Formation of oospore.
,, 8.—Antheridium, the fecundating tube of which has been isolated by artificial evacuation of the oogonium.
,, 9.—Young oospore covered by the reticulated epispore.
,, 10.—Ripe oospore, with thick epispore.
,, 11.—Oospore, with epispore detached, and with remains of fecundating tube.

The Organisms in Yeast.

By Henry C. A. Vine.

A Paper read to the Members of the Bath Microscopical Society, May, 1884.

Plate 25.

THE amount of material at disposal renders it somewhat difficult to deal with the subject of organised ferments, even within the limits indicated by my title, in a manner at once succinct and comprehensive, and careful consideration has been necessary as to the best manner in which it could be placed before our readers. The chief points of past research, the outlines of the methods which have been, and most conveniently may be, employed in such investigations, and finally the nature and classification of the organisms themselves, all in turn demand, and must receive, a share of attention.

The announcement of the discovery of the "yeast plant"—as it was called, by Schwann and Cagniard-Latour some fifty years since—caused considerable attention to be directed to the study of ferment life; but the theories of the nature of the fermentative and putrefactive changes, elaborated by the illustrious Liebig, led to the idea that the organised structures observed in fermenting liquids were the *concomitants* rather than the actual agents of the

fermentative changes; and, as was remarked by Dr. Charlton Bastian in a paper read before the Pathological Society of London, in 1875, "it was not until twenty years afterwards that Pasteur announced, as the result of his apparently conclusive researches, that low organisms acted as the invariable causes of fermentation and putrefaction, and that such changes, though in fact chemical processes, were only capable of being initiated by the agency of living units." Having shown thus much, M. Pasteur proceeded to demonstrate that, not only were the living cells the active cause of change, but that the nature of the change varied according to the species of cell-life employed; that any one species of such cell-life was not capable of conversion into any other variety; and that one species would flourish in a medium in which another could not continue to live. It should be borne in mind that these investigations were carried on in connection with the industrial processes of brewing and wine-making, and that therefore the results obtained have especial bearing upon the present subject.

It was necessary at the commencement to obtain supplies of the various moulds and ferments free from admixture one with the other, and from extraneous cell-life, which might interfere seriously with the experiments, and for this purpose a plan was adopted which serves at the same time to prove the universal presence of these agents of change in the atmosphere and elsewhere. Liquids capable of sustaining the growth of such ferments as it was desired to study were placed in glass flasks, the necks of which were drawn out to a point before the blow-pipe, and after certain means had been taken to destroy whatever vital germs they might contain, they were hermetically sealed and put by for long periods, in order to see whether their contents remained unchanged. When a number of such flasks had remained a considerable time without exhibiting any sign, either of fermentation or of life, they were taken to various parts of the building wherein the laboratory was situate—some, even, into the garden—when, the narrow extremity of the neck being broken, air was admitted. The flasks were then immediately re-sealed, and were restored to their former position upon the shelves of the laboratory. In a few days the presence of small specks of mould upon the surface of the liquid within, or the rising of big bubbles of gas, gave evidence that with

the air some germs of moulds or of ferments had entered, and in the majority of cases it was found that the organisms developed in each flask were limited to one particular species, the amount of air admitted not seeming sufficient to carry with it any great number or variety of organisms. Where this was the case, an uncontaminated growth of mould or ferment was obtained, and formed the material for a series of successive cultivations in supplies of germ-free, nutrient liquids, conducted with proper precautions to secure freedom from accidental errors. The results showed that, although the moulds and mildews were capable, under some circumstances, of acting in a degree as alcoholic ferments, yet each species retained its individual character, instead of exhibiting that polymorphism which had previously been claimed for the group. It was also found that, in each instance, the nature of the fermentation was in accord with the description of the cell-life present, and in some instances, further, that the various nutrient liquids were by no means equally capable of supporting the life of all the species of organisms concerned in such changes. From this it became clear that the injurious changes in materials and produce, from which various industries often suffer, might reasonably be ascribed to the action of these organisms whose universal prevalence would go far to account for the mystery hitherto attaching to such changes. Further investigation showed that such actually was the case, and that the acetic, the lactic, the putrefactive, and other similar fermentations were, like the alcoholic fermentation, due to the development in the affected medium of certain special varieties of organism, each variety producing its particular effects.

In the meantime, these conclusions and theories received great support from the results obtained by those scientists who had been endeavouring to apply them to the elucidation of the history of certain diseases, and the valuable knowledge obtained in this field of research by Pasteur, Koch, and others on the Continent and in this country, have, while rendering great service to humanity, confirmed in a remarkable degree the reasonings of Pasteur with regard to industrial ferments. The same branches of study have furthermore been pursued from another and independent standpoint by some of the leading Continental botanists, who, however, whilst agreeing as to the effect and action of these organisms, differ con-

siderably as to their exact nature and classification. This, then, is, briefly speaking, what has been done in the investigation of ferment-life, and I will now detail certain methods of procedure which may conveniently be employed in such enquiries, and point out the grounds on which their value depends.

In the first place, in order to study the life-history of any animal or vegetable organism, we need to obtain satisfactory and uncontaminated specimens, which, as regards many species, especially of the moulds, may be readily accomplished by the means already described as employed by M. Pasteur. But where it is desired to study the principal organism in yeast—the "yeast-plant" itself—the most convenient way is to cultivate ordinary yeast in successive solutions of cane-sugar, until microscopic examination shows that such other organisms as were at first present have disappeared, when the weakened yeast-cells may be re-invigorated, and a pure crop obtained by another culture in well-boiled malt-wort, which supplies the needful protein matter, as well as the carbo-hydrates of the sugar-solution. Often, commercial yeast, as obtained from the brewery, may be utilised directly for many purposes of study; but it should be noted that, whilst, in many instances, such yeast is almost wholly free from foreign organisms, in other cases, and especially where the liquid drainings can be had, foreign organisms are found in very large amount. Where it is wished to make a rough separation of the more minute cell-life, it may easily be done by means of filter-paper, the pores of which admit the passages of such cells as the *Bacterium lactis* and similar minute species. Having obtained the necessary supply of material, the next thing required is to cultivate it, or breed it, under favourable circumstances, so that its development may be watched and the changes that take place noted.

In the study of the higher plants, the botanist avails himself for this purpose of the aquarium, the greenhouse, and the garden; but in the case of these minute plants which are now under consideration, not only must a suitable soil, so to speak, be provided for their nutriment, but they must be protected in an effectual manner from the intrusion of those germs of cell-life, which are practically omnipresent, and from which, therefore, both the nutrient liquids and the circumambient air must be absolutely

freed. At first, it was thought that a brisk boiling of the cultivating liquid for a short time would effectually destroy any organic life that might be present, seeing that protoplasm is coagulated at a temperature far below the boiling-point of water, and that by sealing up the flask while ebullition was still in progress, the liquid within would be protected from aërial contamination; and there can be no doubt that, within certain limits, both these propositions are perfectly correct. But it is evident that the sealing-up of the flasks in this manner at a temperature of ebullition, however appropriate for elucidating the beginnings of life, is inconsistent with the cultivation of cell-life in the manner we require, and another difficulty arises in the fact that the efficacy of a few moments' boiling for the destruction of such organisms as may be present, is by no means certain, unless the absence of certain special forms be first assured.

The first point—that of excluding aërial germs from a liquid which had been—in whatever manner—rendered *sterile*, under conditions which at the same time admit of the practical culture and study of any desired organism, was met by the employment of Pasteur's cultivating flasks, having a long, narrow, curved neck, which is plugged with cotton wool, and a shorter side-neck, with India-rubber collar, capable of being closed with a glass plug. The liquid being boiled in such a flask, the escaping steam destroys in its passage any germs of life which may exist, either on the interior surfaces of the flask, or in the cotton wool through which it makes its exit, and when, on the flask cooling, the air re-enters, the latter serves as an effectual filter for the stopping of any particles which would otherwise be introduced, whether living germs or otherwise. If we presume for a moment that this boiling is sufficient for the destruction of organised life, we shall now have a nutrient liquid free from the agents of change, and surrounded by an equally pure atmosphere, into which the organism to be cultivated is introduced or "sown" by dropping in a bit of platinum wire, or foil, which, after being heated to redness, is touched with the organism to be cultivated, so that a little adheres, and is admitted to the flask by the momentary removal of the stopper in the short neck. If the manipulation be conducted with ordinary dexterity and speed, no harm is likely to arise from the short

contact with the external air involved in the removal of the stopper. But another and more formidable difficulty appears, as to how to ensure the sterilisation of the nutrient fluid. Dr. Charlton Bastian has stated, in his "Beginnings of Life," that even in flasks hermetically sealed, it by no means follows that, because the liquid (infusion or what not) has been boiled, no development of organisms, and consequently no fermentation, will take place; in fact, he asserts that the preservation of the liquid unchanged in such flasks and under such conditions is the exception rather than the rule. How, then, is this to be met? In support of his views, Dr. Bastian brought forward numerous experiments made with infusions of turnip and fresh cheese under the above conditions, by which it was clearly shown that mere boiling by no means ensured the destruction of ferment-life in an organic liquid; whilst, on the other hand, Pasteur points to flasks of malt infusions which had remained many years *—in some instances, I believe, as many as twelve—on the shelves of his laboratory unaltered, although only separated from the internal atmosphere by a plug of cotton wool. In a celebrated lecture delivered some years since, Professor Tyndall showed that infusions of hay could not be freed from germ-life by simple boiling, even when continued for several hours, and that such a result could only be arrived at by repeating the process several times with special precautions. It was also found by Cohn that the same thing held good to a greater or less degree with other infusions, and by this observer it was soon noticed that, whatever species of germ-life might be present before ebullition, any development which appeared afterwards was invariably of the genus *Bacillus*,† and that in the absence of organisms of this genus, complete sterilisation could be effected by boiling.

It is not necessary now to enter into the question of the germination—if such it be—of *Bacillus* from spores, for as those liquids which are most suited for our present purpose, rarely seem to contain either *Bacillus* or its spores, it is not of immediate importance, and so far we may feel satisfied of our ability to destroy the germs of life in our cultivating fluids. Pasteur, in his

* "Etudes sur la Biére," L. Pasteur, p. 28.

† "Quar. Jour. Micro. Science," 1877, p. 83.

"Etudes sur la Biére," says of this :—"Experiment has proved that an ebullition of some minutes gives, to a malt infusion specially, an absolute freedom from change when in contact with pure air—that is to say, with air deprived of the organic germs which it invariably contains,"* and as such infusions are among the best media for the culture of industrial ferments, and as any doubt as to the ready *practical* sterilisation of the nutrient fluids employed would render the results obtained worthless, I have thought it well to refer to some special examples. Some weeks since, a friend prepared for me a series of flasks, containing malt infusions, and as he was unaware of the object for which the preparations were made, and simply acted on my instructions conveyed through a third party, no preconceived ideas of mine could in any way have affected the result. The infusion was made from a good sample of malt in distilled water at about 180° F., and was filtered hot into the flasks, which, after the closing of the necks with cotton wool, were briskly boiled, each for some ten minutes. They were then placed on a shelf, where they remained for a considerable time, and, with the exception of an albumenoid precipitate, which formed on cooling, the contents have remained unaltered, and without the slightest indication of the presence of ferment-life. It may be useful to point out that the same thing has been shown to be true of milk, and of the liquid known as "Pasteur's cultivating fluid," by Professor Lister, who has given the name of *Bacterium lactis* to the organism to which the acid change in the former is due—and others; while Dr. W. Roberts, in his address before the British Medical Association at Manchester in the year 1877, exhibited a great number of organic infusions and secretions which had been rendered permanently sterile by the application of proper means for the destruction or removal of organised cell-life. We may, therefore, be satisfied that cultivating liquids may be readily freed from the germs of organised life, and also that, practically speaking at any rate, no confusion or error is to be apprehended in our cultures from any spontaneous evolution of organised cells.

The next step is to ascertain what media are best adapted to the culture of the special class of organisms which it is desired to investigate. And that such is not an immaterial point is shown by

* Etudes sur la Bierre, chap. III., p. 33.

the fact which Prof. Lister has brought forward—viz., that the *B. lactis* (the lactic ferment) refuses to live in Pasteur's "Cultivating solution," and also by the fact, that while the yeast-cell only lives with difficulty in a solution of sugar alone, and is not able to multiply in such a medium, similar conditions are actually destructive to the life of the more minute organisms which are usually also present in commercial yeast, and that on this fact a practical process of yeast purification has been based. Moreover, those organisms develop most readily and most freely in the nutrient fluid to which it is best adapted, and where a number of dissimilar ferments are placed in an organic liquid, some will usually increase to the exclusion, and sometimes even to the extinction, of those of weaker growth, or those to which the nutriment is less suited. It is, moreover, a well-known practical fact to brewers, that the nature of the development of cell-life which takes place during and after the fermentation of their worts, is largely dependent on the character of the nitrogenous and carbo-hydrate constituents. It is, then, beyond doubt necessary to choose the cultivating medium with special reference to the type of organism we wish to cultivate.

Liquids adapted to be the soil for the nurture of certain classes of organisms have been devised by Cohn and by Raulin—the latter having been utilised by Pasteur—while grape-juice, malt infusions, and various animal secretions, have been employed by various observers according to the nature of their studies. For such investigations as we are now considering, I have already mentioned that an infusion of malt affords a convenient and suitable medium, and it may, if necessary, be supplemented by other preparations, such as the nutrient fluid of Cohn, if it be desired to cultivate separately the more minute organisms which are usually associated with the germ-cells themselves. The malt from which the infusion is made should be of the best quality procurable; by preference a malt made from barley grown and ripened in a hot country; or where a good brewer's wort can be obtained, this may be substituted, diluting it to a standard strength—some 40° to 50° specific gravity will answer the purpose—with distilled water. This infusion being placed in a number of cultivating-flasks, and boiled as before described, is placed on one side for a time to ensure the

absence of ferment-life, and when it is desired to start a culture, the material is introduced at the side-neck, and the flask or flasks being retained at a suitable temperature, the development rapidly takes place. The basis on which the culture proceeds, and the means to be adopted in order to ensure reliable results, having been dealt with, it remains to consider what it is which we are about to cultivate in these carefully-prepared flasks.

Yeast, in its ordinary form and when fresh, consists of a light, yellowish, more or less pasty mass, composed mainly of minute unicellular organisms, mixed with a certain amount of the fermenting liquid from which it has been removed, and more or less carbonic-acid gas. It is with the organisms that we have now to do. These consist, firstly and chiefly, of the "Yeast-Plant" of Schwann, the cells of the *Torula cerevisiæ* or, as it has more recently been called, the *Saccharomyces cerevisiæ*, which are shown in Plate 25 at Nos. 1 and 2, as seen under a quarter-inch objective, and in Nos. 3, 4, 5, and 6 under a one-tenth immersion objective, with No. 3 oc., together usually with certain nearly allied species of Saccharomyces, and of a few cells of the *Bacterium lactis* (shown in the Plate at No. 8, as seen under the one-tenth inch objective). But usually one finds also more or less of those varieties of ferment-life which Pasteur has designated as the "ferments of disease" (*ferments de maladie*). Those which are most commonly met with, in addition to the lactic cell—which, unless present in large quantity, is not generally considered as injurious—are the thin acetic rod, or filament, which produces acetic acid (No. 7), and more rarely the butyric ferment, the *Bacillus subtilis* (No. 9), the minute *Saccharomyces apiculatus*, (No. 12), and other forms of less importance.

Before proceeding to describe these, it will be as well to glance for a moment at the various views of the nature and classification of these organisms which have been advanced by different observers. Von Naegëli, in a valuable work, published in 1877, considers them all as belonging to the Fungi, and as nearly related to the moulds or mucedines, although, as he points out, this connection is only traceable so far as those organisms of which the *Torula cerevisiæ* may be taken as the type. He divides them into two groups only, making the "moulds" into a third, and describes

them as "Sprouting Fungi," in which are included yeast-cells of different kinds, which increase by means of sprouts or buds from the surfaces, and "Cleft-Fungi," or *Schizomycetes*, more minute spherical, ovoid, or elongated, all which multiply by fission only, and which, sometimes retaining a slight connection one with the other, form unbranched rows, rods, etc.

Of the first division, there can, I think, be very little doubt as to the closeness of the relationship between it and the *moulds*, as from Pasteur's researches the latter appear capable, under certain circumstances, of assuming the functions of an alcoholic ferment, and at the same time modifying materially their characteristic features and development. Of the "Cleft-Fungi" Naegëli says:— "I have during the last ten years examined some thousands of different fission ferment-cells, but (excluding *Sarcinæ*) I could not assert that there was any necessity to separate them into even two specific kinds." Hence he considers that all the organisms which multiply in this manner, however varying in shape, are best considered as one class, which he places among the Fungi under the name of *Schizomycetes*. These views are to some extent supported by Cienkowski, who, while considering many of the Bacterial forms to belong to the Algæ rather than to the Fungi, does not see sufficient ground for distinguishing them into numerous species. On the other hand, Cohn, and many other highly-skilled observers, hold entirely different opinions, considering that sufficiently distinguishing features exist to admit of an elaborate classification, though to some extent of a provisional nature, and viewing Naegëli's *Schizomycetes* as nearer allied to the Algæ than to the Fungi, have placed them with the former under the name of *Schizophytes*. Pasteur, who has investigated the subject from a more purely technical point of view, has not troubled himself with nomenclature further than was necessary for his immediate purpose, and has adhered to the old terms. I am not prepared to commit myself to any definite opinion as to the whole subject, but I may point out that the difference in the action of certain well-defined form-species, and the fact that the medium which will support some varieties will not meet the requirements of others, indicates in an unmistakeable manner that certain definite varieties exist differing in other points beyond mere form. Some years since, Dr. Roberts pro-

posed to utilise the term *Saprophytes* to include all organisms concerned in putrefactive or fermentative changes, and for the present I propose to adopt it, employing where necessary such distinctive terms as are most generally understood.

The "Yeast-Plant" of the earlier observers, the *Torula cerevisiæ*, consists of a spherical or ovoid cell, having an interior albuminous lining containing protoplasm, and an outer coat of cellulose, which may be distinguished by means of re-agents. The protoplasm appears to be devoid of chlorophyll, and in mature samples several small vacuoles and minute spherical bodies, some of which are evidently of an oily nature, are to be observed; whilst in most cells is a more or less developed spherical vesicle, generally towards one side, and the contents of which are evidently liquid. This formation will be seen on reference to the plate, and is especially noticeable in No. 3, which was obtained from a very old stock in a Northern brewery, and less so in Nos. 5 and 6, which are from Burton. This vesicle not infrequently contains a remarkably spore-like spherical body, but which, in the majority of specimens, especially from breweries where what is known as a "fast" fermentation is carried on, does not seem to develop fully. In the sample shown at No. 3, and in others from the same source, the cell-wall and the border of the vesicle alike exhibited a degree of firmness; while the interior spore-like body was large and well developed, and possessed a rapid, gyratory movement within the vesicle. I have on several occasions been fortunate enough to observe this movement, which I believe is hitherto unrecorded, and under a power of some 1,500 diameters it can be watched with the greatest certainty. But I have not been able to satisfy myself as to the manner in which this movement is brought about, although the peculiar jerky gyrations suggests the idea that it is due to the action of cilia or flagella, and if so, suitable illumination will no doubt enable us to detect them.* I have never been able to find any indication of such motion in any specimens of Burton yeast, though I have received a very great number, neither is it usually to be found in the yeasts from the

* Since writing the above the Author has placed specimens in the hands of a friend, by whom, after careful examination, the movements are pronounced to be undoubtedly due to the influence of heat, and are probably identical with those known as Brownian movements.

breweries of the West of England. In some of the specimens, and notably in the one from which the drawing was taken, it endured for at least a week. The nutrition of the cell appears to be effected by a process of osmotic diffusion through the cell-wall, a continual transmission of nutrient material going on from the surrounding liquid towards the interior, where it is assimilated as food, and a reverse or outward action, by which we may presume some excretory products are removed, simultaneously proceeding. Hence we may assume that only diffusable substances are capable of sustaining the life of the Yeast-cell, but how far it possesses the power of rendering materials which may be presented to it fit for its assimilation and sustenance is another thing, and one which, though deeply interesting, I must pass by for the present.

The presence of oxygen gas, or of some carbo-hydrate or other compound, by the decomposition of which oxygen can be obtained, and of some protein material, in this nutrient medium, from which the cells can derive nitrogen in some form, are essential to its life and development. The exact condition in which this nitrogenous nutriment is absorbed is a matter of considerable technical importance, and is at present occupying my attention. The multiplication of the cell takes place by a process of *gemmation*, or budding, and though it is not unlikely that considerable additional knowledge on this head will be gained in the future, yet it would seem that if any other mode of propagation exists, it very rarely comes into operation. The parent cell, when placed in a medium affording a supply of readily-assimilated nutriment, rapidly assumes a fuller and more transparent appearance, and after a time extrudes a bud of protoplasm, which, itself absorbing sustenance like the parent, soon equals it in size, and puts forth a second generation—if that word may be allowed for such a process. Thus, if food be abundant, and the other conditions not unfavourable, a rapid increase of cells takes place, and as they rarely part company immediately, they often form chains of considerable length, half-a-dozen or more remaining together. This process is shown in the drawings in the upper part of the plate, Nos. 4, 5, and 6 of which show the changes taking place in a fermenting wort at intervals of forty-eight hours. The result of the vital action of the cell is the well-known formation of alcohol and carbonic acid, and certain

small amounts of other products, as Glycerine and Succinic Acid, and the removal of a small proportion of the nitrogenous constituents, but the exact manner in which these changes are brought about is yet to be satisfactorily ascertained.

Of the other organisms which are present in commercial Yeast, the most common beyond doubt is the Bacterium, which sets up the lactic change, the *Bacterium lactis* of Lister, by whom it is described in the *Quart. Journ. Micro. Science*, as "being somewhat peculiar in the form of its segments, which are oval, and not so rod-like as Bacteria generally"; whilst Dr. C. Graham, in his Cantor lectures of 1874, describes them as "little organisms of the shape of a figure 8, two round circles together"; and Pasteur says, "Small articulations, slightly strangled in the middle, generally isolated, more rarely joined in chains of two and three." I have been particular in giving these descriptions, as these cells are often somewhat difficult of recognition. They are shown in the Plate at No. 8, as seen under a 1—10 in. objective; but I am afraid the drawing includes some other Bacteria besides the *B. lactis.* There is no reason to doubt that this organism, in common with most others of the kind, assimilates its nutriment in a manner similar to the cells of *Torula cerevisiæ*, but it is devoid, so far as my experience goes, of any appearance of the internal structure (so to speak) which is visible in the latter, and it is so much smaller in size as to be readily separated from it by means of filter-paper. It is in the strict sense a fission-cell, multiplying, according to Professor Lister, "by fissiparous generation, the lines of segmentation being transverse to the longitudinal axis of the organism," * and when observed, it is generally in some stage of division. It is not a common organism in the ordinary atmosphere, but when once present in a favourable soil, developes with great vigour, to the hindrance of any other weaker species. It is to be found in milk when souring, and in malt infusions, especially developing in the latter when retained at a slightly warm temperature, and brings about in both, the resolution of the saccharine matter into lactic acid. Even a good Yeast is scarcely ever seen altogether free from this organism.

* "Quart. Journ. Micro. Science," 1878, p. 184.

A much more objectionable organism which is frequently to be found is the acetic ferment, is shown in the Plate at No. 7, as seen under the 1—10 in. objective. Under a low power it is visible simply as a thin rod or thread, but the higher power reveals an appearance of segmentation. By the agency of these filaments, the alcohol of beer or wine in which they appear, is converted more or less into acetic acid, and whilst they are dreaded by the brewer, and considered by him as a ferment of disease, they are utilised as an industrial agent by the vinegar-maker, whose mucilaginous ferment consists essentially of them, and I should therefore describe them as the *Mycoderma aceti*, had this name not been already applied by Pasteur to another form; hence, to avoid confusion, I use the term, acetic ferment. From the peculiar movements of these rods, especially at their extremities, I am inclined to think that they are provided with flagella, but am not aware that any observation of them has been recorded. These organisms also multiply by transverse fission, and although I have seen some appearances indicative of the formation of spore-like bodies, I am by no means inclined to advance any opinion as to any such means of increase. The sediment of beer or porter which has become somewhat acid will always afford a plentiful supply of this organism, which may be cultivated in a little thin wine or beer. An intruder more rarely seen among the Yeast-cells is the *Bacillus subtilis*, the celebrated Bacillus of the hay infusions, or, at any rate, an organism precisely similar to it in all respects, by which butyric fermentation is induced. It is shown in the Plate at No. 9, and is too well known to need a detailed description. Messrs. Dallinger and Drysdale, by the use of extremely high powers and very careful illumination, have satisfied themselves that this organism is possessed of flagella, and their well-known researches render it probable that such appendages are general among the Saprophytes at some stage of their existence.

The only remaining varieties of organised ferments likely to be met with associated with the Yeast-cell are the *Mycoderma cerevisiæ*, the mould which so quickly forms on the surface of malt infusions exposed to the air, and which when submerged acts as an alcoholic ferment—it is shown at No. 11 on the Plate; the *Saccharomyces apiculatus* (No. 12), a small cell, inducing a peculiar acid change

in worts and beers, and which has recently been investigated at length by C. Hansen, of the Carlsberg Laboratory; and certain Bacterial forms (No. 10), which, by their power of inducing a gelatinous formation, sometimes cause much injury in manufacturing operations. These species are, however, rarely met with in ordinary yeast; at any rate, in this country. They are more commonly to be found in worts, or in beers themselves, than in the yeast which is used to start the fermentation.

EXPLANATION OF PLATE XXV.

Fig. 1.—Saccharomyces from the yeast of a Burton Brewery.

,, 2.—Ditto from a West of England Brewery, where artificial saccharine is used.

,, 3.—Ditto from a Northern Brewery, showing round or spherical cells. (1-10th in. obj., 3 oc.)

,, 4. ⎫ Cells of Saccharomyces in different stages of development,
,, 5. ⎬ in the fermentation of a brewer's wort; taken at intervals of
,, 6. ⎭ 48 hours. (1-10th in. obj., 3 oc.)

,, 7.—Acetic ferments employed in vinegar making. 1-10th in. obj., 3 oc.

,, 8.—Cells of B. lactis, shewing increase by sub-division, 1-10th obj., 3 oc.

,, 9.—Cells of Bacillus subtilis, from a brewer's wort when putrid, 1-10th obj., 3 oc.

,, 10.—Bacteria inducing a ropy or gelatinous change, 1-10th obj., 3 oc.

,, 11.—Mycoderma cerevisiæ, as found in stale beer or malt infusion, 1-10th obj., 3 oc.

,, 12.—Saccharomyces apiculatus from a peculiar acid beer, 1-10th obj., 3 oc.

On the Collection and Preparation of the Diatomaceæ.

By Alfred W. Griffin.

Part II.—Preparation.

HAVING accumulated a number of gatherings and rough material which contain specimens of Diatomaceæ, the next step is to clean and preserve the Diatoms for future use and study. If any microscopist wishes to mount a few slides, the process of cleansing by Nitric Acid is certainly the easiest, and there is no necessity to refer further to it here; but I would add that whilst occasionally very clean specimens may be obtained, yet, in the majority of cases, they are far from satisfying the critical eye of the experienced mounter. A few of the most approved and satisfactory methods I will now mention, remembering that even these will have to be modified according to the nature of the materials to be operated upon. These materials, for convenience sake, I will divide into the following series:—recent gatherings; muds; guanos; lacustrine, marine, and fossil deposits.

In recent gatherings, there will, in all probability, be a large quantity of sand or other earthy admixture which it will be as well to remove before commencing to use the acid. This is best accomplished by pouring clean water upon the gathering, and then decanting off the supernatant fluid; the siliceous particles being the heavier, will have fallen to the bottom of the glass, which should be of a conical shape. After an interval of about two hours the water containing the diatoms should be examined, and when it is found that they have subsided to the bottom of the glass, so much as is possible of the fluid should be poured off from the sediment, leaving it nearly dry. The Diatoms must now be transferred to a strong test tube; and covered with Nitric Acid to the height of an inch. Effervescence usually takes place in a few minutes, and it will be well to wait until this subsides. The test tube is then to

be held over a spirit-lamp and carefully heated until the reaction of the organic matter ceases; and, while the liquid is still hot, Professor Meade Edwards recommends the addition of one or two fragments of Bichromate of Potash to bleach what organic matter may still remain.

The next step in the process is to pour the contents of the test tube into a jar of clean water, at the same time rinsing out the test tube, and adding the result to the rest of the water containing the Diatoms, which should now be allowed to settle for three or four hours at least. This being accomplished, pour off about two-thirds of the fluid, adding fresh water, and repeating the process till all acidity is removed, which may be proved by its ceasing to redden litmus paper. Careful attention to this particular will prevent the operator falling into a common error, whereby many beautiful specimens are rendered unsightly when mounted. The residuum will, in all probability, consist of a white flocculent mass, which must be transferred to a bottle containing water and a few drops of Carbolic Acid or a little alcohol, to prevent the formation of confervoid growth, and the matting together of the diatoms.

Mud, according to Professor Edwards, requires to be treated in a somewhat different manner. If it is dry and lumpy, it will have to be broken down by boiling for a few minutes in a mixture of *Liquor Potassæ* and water, in equal parts; after it has passed into the state of soft mud, all the potash must be washed out, by frequent additions and decantations of clean water. To the mud thus prepared Nitric Acid must be added, as in the case of recent gatherings, followed by the use of the crystals of Bichromate of Potash, as already described.

It not unfrequently happens that the Diatoms are insufficiently cleaned by this means; the sediment must, in such case, be poured into an evaporating dish, with sufficient pure Sulphuric Acid to cover it, and the vessel gradually and carefully heated. To avoid any chance of explosion, so soon as the white fumes of the acid appear, Bichromate of Potash should be added in small portions, and when the green colour formed by its reaction on the organic matter begins to assume a yellowish tint, a few drops of Hydrochloric Acid must be added. The liquid should

now be set aside to cool, when the deposit must be finally washed as has been already described. There is another process which is substantially the same as the one already described, but with this exception, Sulphuric Acid is substituted for Nitric Acid, and crystals of Nitrate of Potash for those of bichromate. This has, I think, some advantages over the first-mentioned process, and, as I invariably follow it, I have the greatest confidence in recommending it. When a recent gathering is nearly pure, all that is required is to burn it on a platinum plate over a gas flame, the organic matter being quickly carbonised, while the beautiful siliceous shields alone remain unaffected.

GUANOS.—The preparation of these substances so as to obtain the Diatoms mixed with them, is unquestionably tedious and dirty; but I would qualify this somewhat discouraging remark by stating that these ammoniacal guanos contain by far the most beautiful forms, and the result is therefore well worth the labour bestowed. As a type of this we will take some Peruvian guano, first sifting it to free it from stones, feathers, and other *débris*. The finely-sifted material should be slowly dried in an oven, which causes the evaporation of a considerable portion of the ammonia, and most of the moisture with which it is so frequently charged. A tin pan or skillet is now to be half-filled with a strong solution of commercial Carbonate of Soda, about three ounces of *sodæ carb.* to the pint of water, and placed over a gas-stove, and on the liquid boiling the guano is gradually and slowly dropped in. It is necessary frequently to stir the solution to prevent its boiling over, owing to a considerable effervescence produced by the Soda on the Ammonia of the guano. When the liquid ceases to effervesce, it is poured into a plentiful supply of clean water, and washed several times, taking, of course, every care that the frustules of the Diatoms are not washed away in the process. A red-looking mud is the result of this process, which, on boiling in Sulphuric Acid, treating with Bichromate of Potash, and finally washing, will yield some very clean and beautiful specimens. The best guanos for treatment are without question those of Pabellon de Pica, Isle of Maccabees, Patos, and Old Ichaboe. In reviewing the work done, it will be well to consider the effect of the acids used, always remembering that Hydrochloric has a low boiling point, Nitric

Acid boils at a moderately high temperature, and Sulphuric Acid the highest of all; so that every attention must be paid to the quality of the test tubes or flasks used. The primary use of the acids is to remove all the lime compounds, and to assist in the destruction of vegetable matter; the addition of the Nitrate of Potash is to bleach the residuum, but the sand remaining, being indestructible, can only be got rid of by frequent washings and decantations.

Lacustrine and sedimentary deposits as those of Dolgelly, Mull, Mourne Mountain, Kieselgühr, Franzenbad, and Loch Kennard are so pure that little more is required than boiling in a weak solution of Caustic Potash, and subsequent washing. Should there be an unusual quantity of organic matter, recourse must be had to Bergen's method, which is the Sulphuric Acid and Nitrate of Potash treatment, already described.

Marine and fossil deposits of the character of South Naparima, in the island of Trinadad, Moron in Spain, and the so-called Marls of the island of Barbadoes, and all those of a stony and rough nature, must, before boiling with Sulphuric Acid, go through that operation in *Liquor Potassæ*, till the whole mass is broken down into a soft mud. The liquid containing this in suspension is poured into hot water, and after a space of three or four hours all Diatoms will have fallen to the bottom of the vessel, the resultant mass must be boiled in Hydrochloric Acid for about twenty minutes, then a few drops of Nitric Acid added, again washing out the acids and finally boiling with Sulphuric Acid, and decolourising with Nitrate of Potash. The work of isolation and separation into densities must now be proceeded with, and I subjoin Professor Meade Edwards' method which I prefer to many others, as I venture to think it is the easiest and shortest. Into a beaker-glass of the capacity of an ounce, the cleansed Diatoms are to be poured, filling up the glass with clean water; this is then stirred with a glass rod, and after an interval of six seconds, poured slowly into a larger vessel, taking care not to disturb the sand or earthy matter which may have settled. The beaker must be again filled with water, stirred, and allowed to settle for the same interval, and poured into the same receptacle. When this has been repeated about six times, all the sand free from Diatoms

will be found at the bottom of the first vessel, which may of course be thrown away with every feeling of satisfaction on the part of the operator. When the material in the larger beaker has settled, it is poured back into the smaller one, and the foregoing process repeated, the densities varying according to the time allowed for their settlement, and if the patience is not quite exhausted, as many as six or seven densities may be obtained, containing forms varying very much from each other.

The larger forms, as *Triceratium*, *Coscinodiscus*, and *Heliopelta*, are to be found in the coarsest density, and the broken forms in the lightest. When it is desired to preserve such forms as *Dickeia* and *Schizonema* in their natural condition, I think there is no better process than that of Herr Hantzsch of Dresden, the advantage of whose method is, that a gradual application of the preservative fluid is brought about, the action of endosmose slightly retarded, and there is also a better adjustment of the density within and without the vegetable cell. The fluid he recommends is composed of

3 parts Pure Alcohol,
2 „ Distilled Water,
1 „ Glycerine.

A cell having been made of Gold size and allowed to become "tacky," a drόp of distilled water is laid in the centre, and in this the Diatom or Diatoms are placed, and then a few drops of the preservative medium added. The slide must be laid aside for awhile, and covered with a bell-glass to exclude the dust; after a short time it will be found that the glycerine alone remains, more of the liquid must be added, and subsequent evaporation submitted to, till the cell becomes full of glycerine. The cover-glass should now be applied, a thin ring of gold size is drawn round the edge of it, which will temporarily secure it, and on this becoming hard, the cell is finished with gold size and varnish in the usual manner.

A somewhat new medium has been recommended by that celebrated Diatomist, Dr. Von Heurck, which is a solution of Styrax in benzole or chloroform; personally I prefer the latter. Mr. A. C. Cole, of London, refers to it at length in a recent number of his "Popular Studies," therefore I do not think it

necessary to take up the time of those who have read it, but will simply add that I have almost discarded Balsam in Benzole, and use the Styrax solution in preference. I have made a series of experiments with some sixteen other media, but none have proved so satisfactory for cleanliness and clearness of resolution. The refractive index of Styrax is, I believe, much the same as that of Monobromide of Napthaline.

Some little attention has been drawn of late to the mounting of diatoms in a solution of Biniodide of Mercury and Iodide of Potassium; but whilst the image is without doubt somewhat sharper than when mounted in Balsam, still, the possibility of the breakage of the cover-glass, and the consequent escape of the mercurial solution over the objective and the brass work of the microscope seems hardly worth the risk, especially when it is borne in mind that the refractive index of styrax is even higher than that of the fluid just named. Canada balsam has an index of 1·54, the solution of Mercury and Potassic Iodide, 1·68; next follows Styrax, and finally Phosphorus, with that of 2·1.

A few remarks on the latter medium may not be out of place, both as regards its solution and the method of using it. It is necessary to procure clean, semi-transparent Phosphorus, and having cut off, under water, some large pieces with a pen-knife, place them for a few seconds on a piece of white blotting-paper to free them from the slightest suspicion of water. Before commencing, the operator should be provided with a small basin of water in which to place any article that has been touched with the phosphorus solution to prevent accidental combustion. And as this medium is liable to oxidation, it is better to make but a small portion at a time—that is to say, one drachm of Phosphorus to two drachms of Bisulphide of Carbon. When the former is quite dissolved, slightly damp a piece of filtering paper with Bisulphide of Carbon, and with a very small glass funnel placed in the neck of a stoppered bottle carefully filter the solution. Place the glass funnel and the filtering paper, when used, in the basin of water to prevent accident. Supposing the diatoms are preserved in a small tube of water and spirit, all that is required is to place a drop of the fluid on the cover-glass, and slowly evaporate the medium over the flame of a spirit-lamp or jet of gas.

When the cover-glass has become quite cool, place on the margin of its edge a mere speck of Canada Balsam, the object of which is to keep the cover, with its surface covered with diatoms, face downwards, in the centre of the glass slip. By means of a pipette, take a few drops of the solution of Phosphorus, and place them on the edge of the circle, and by capillary attraction they will be immediately drawn under, displacing the air in their progress.

Having ascertained that the diatoms are completely immersed in the medium, remove all superfluous particles of Phosphorus with a piece of blotting-paper damped with Bisulphide of Carbon, and consign it also to a basin of water. Finally, place the slide on the turn-table, and with a brush dipped in Walton's Glucine or Kay's Coaguline (the former we think the best) draw a ring round the edge of the cover-glass. In all probability, this will be dry in the course of about six hours, when if necessary another ring of the cement may be added, covering this with a further application of shellac varnish, or asphalt, and, as a last layer, any coloured cement that the fancy of the operator may dictate.

Diatoms that are almost indistinguishable in balsam show quite clearly in this medium. The structure of *Heliopelta* and *Omphalopelta* are brought out in a remarkable manner, and the same may be said of many of the varieties of *Navicula*, *Pleurosigma*, and *Nitzschia*. I am quite aware that the odour of Bisulphide of Carbon and Phosphorus is by no means pleasing, but this the operator must learn to disregard, as, since it "cannot be cured, it must, therefore, be endured."

As a precaution against burns from the Phosphorus getting beneath the finger-nails, it will be well to anoint the hands with oil or vaseline.

In closing this paper, I would make a slight reference to the mounting of Diatoms in lines and patterns, which may be done in two or three ways; one of which is that a thin solution of isinglass is made in hot water, and lightly brushed over the centre of the slide, and when nearly dry the Diatoms are arranged upon it, according to desire, the cover-glass is placed upon it, and a drop of Canada Balsam in Benzole, or Styrax in Chloroform is placed on the outer edge, when the air is displaced by the incoming fluid, and the isinglass also dissolved

away. When, however, the finer varieties of Diatoms are required as test objects, it is well to mount them directly upon the glass cover. Geisbricht's method is as follows:—The slide is coated with a solution of shellac in absolute alcohol, washing over this with oil of cloves, and when the Diatoms are arranged in patterns, warm the slide, and the oil of cloves is soon evaporated, leaving only the work to be done of putting on the cover-glass, and the filling in with either of the two mentioned media. Much has been learnt of the internal structure of the valves of the Diatomaceæ by a series of experiments made by one of the most prominent Belgian diatomists; however, Mr. Sollas has furnished us with his method, which is as practical as it can well be, and I therefore append it as it appeared in a recent number of the *Journal of the Royal Microscopical Society*:—

"My plan is to scrape off the green slime from our River mud consisting chiefly of *Pleurosigma zigzag*—a large species suitable for cutting. The slime, together with some mud, unavoidably gathered at the same time, is placed in a saucer and covered with a piece of muslin which is to be in immediate contact with the mud, while a film of water lies above it. The saucer is now exposed to daylight, and the Diatoms creep through the muslin, collecting in a consistent film on its upper surface. The muslin may now be lifted from the mud, it comes away clean, bringing all the Diatoms with it, but leaving the mud behind. The muslin with the Diatom film is now immersed in the usual hardening and staining re-agents. I have used a mixture of Chromic and Osmic Acid, and absolute alcohol, for hardening; borax-carmine, hæmatoxylin, and eosin for staining. When duly stained and hardened, the Diatom film may be removed from the muslin without difficulty, and cut, either by imbedding in pure paraffin and mounting in Canada Balsam, or freezing in Gelatine jelly, which allows one to cut *consistent sections which may be mounted direct in glycerine* on a glass slide, without passing through water."

The knowledge which such a process imparts of the internal structure of the Diatom is most important.

Senecio Vulgaris.*

By R. H. Moore.

Plates 26 and 27.

OUR garden-weeds are common enough—so common, in fact, that many are accustomed to pass them by, without giving a thought to their wonderful structure, marvellous beauty, and curious adaptation to surrounding circumstances. I suppose it is quite orthodox and proper to despise the garden of the sluggard, notwithstanding the untiring industry of Nature, which clothes the uncultured soil with verdure. The original curse—"Thorns and thistles shall it bring forth to thee," has clung to the earth throughout all ages.

"Rank weeds, which every art and care defy,
Reign o'er the land, and rob the blighted rye;
O'er the young shoot the charlock throws a shade,
And clasping tares cling round the sickly blade."

In sheer retaliation man gazes on the weedy wastes with proud contempt, or, with more praiseworthy retaliation, arms himself with spade and hoe to destroy these emblems of the fall.

Surely, Nature cannot be blamed for her prolific harvests: far better these than blank sterility, but we may blame a lazy neighbour whose indolent habits render the curse a double one to us, in causing our own gardens to bring forth a prolific crop of thistles, from seeds blown from his. It may be mortifying enough for us to be compelled to eat our bread in the sweat of our brow, but when our toil is increased by a neighbour's own idleness, we feel that we are the victims of an additional curse which ought not to exist, and from which we certainly ought to be spared.

* We deem it right to say that this paper was written for the Bath Microscopical Society, and read before that society two years ago; so that it is quite independent of another on the same subject, entitled "A Bit of Groundsel," by Rev. H. W. Lett, which appears on pages 101—6 of the present volume. Both papers mutually supplement one another, and show how two thoughtful men, writing quite independently of each other, may find much that is new and interesting in the most common subject.—[Ed.]

The student of Natural History, however, is not painfully alarmed, even at the presence of weeds; to him Nature in every form is charming. The coarse-looking and formidable nettle affords him infinite delight; its devices for seed-scattering, its extraordinary hairs with their reservoirs of poison, are to him objects worthy of close and patient research. The simple beauty of the silvery-petalled Chickweed, with its beautifully carved seeds; the prolific Spurge, with its remarkable floral structure, are as much worthy of admiration as our choicest exotics.

We speak of Groundsel as a weed; let me ask, "What is a weed?" If we turn to our dictionaries we shall be told that a weed is "Any plant of small growth that is useless, noxious, or troublesome." If such is a true definition of the word, our pet canaries will undoubtedly declare that the "Groundsel is *not* a weed." The word "weed" is from the Anglo-Saxon, "weod," an herb, and under this term the Groundsel may be safely included.

The *Senecio* is a genus of plants originally found only in Europe and the southern parts of Asia; but like many other genera of our wild plants, it follows in the train of civilisation, and wherever Europeans settle, it is soon established amongst the colonists. The seeds are doubtless carried with the grain which is exported for cultivation on foreign soils.

This genus belongs to the natural order *Compositæ*, which includes also the Daisy, the Chrysanthemum, the Sun-flower, the Aster, and the Dahlia. This order is divided into three sub-orders, and it is to the first of these—viz., Corymbiferæ—that the *Senecio* belongs. The name of this sub-order is derived from "*corymbus*," a summit, and "*fero*," to bear, the plants belonging to it having generally a disc of tubular florets in the centre and a ray of strap-shaped florets in the circumference, although the Groundsel is destitute of the latter.

The order *Compositæ* is one of the largest and at the same time one of the most important natural families in the vegetable kingdom; it contains more than 1,000 genera and almost 10,000 known species. As many as 600 species of *Senecio* (British and foreign) are known, amongst which are included annual, perennial, and half-shrubby plants. Withering enumerates ten British species,

six of which are mentioned by Babington, in his "Flora Bathoniensis," and may be found in this neighbourhood.

All the British species have yellow flowers, and are distinguished by the popular names of Groundsel and Ragwort. The word Groundsel is derived from the Anglo-Saxon, "*Grund*," ground, and "*swelgan*," to swell, because the ground swells with it —*i.e.*, the plant grows everywhere. The name Ragwort is derived also from the Anglo-Saxon "*hraeod*," ragged, and "*wyrt*," a plant, on account of the ragged appearance of its leaves.

Humboldt found Groundsels just below the perpetual snows of the Andes. In an old botanical work I find mention made of fourteen species which are not considered common weeds; they are natives of North America, Madras, Africa, Cape of Good Hope, the Alps and Pyrenees, Paris, and the Levant. *Senecio Pseudo-China*, a plant far too tender for British cultivation, except as a stove-plant, grows on the open ground in Madras, and there are three species indigenous to the Cape of Good Hope, requiring much care during the winter in England if planted out of doors. Another species from the Cape, *S. elegans*, possesses a floral disc of beautiful purple rays, but with the exception of this species and of another with white flowers, all the species of this genus, however tender, have yellow flowers as in this country.

The name *Senecio*, from the Latin "*Senex*," is said to have been given to this genus, either on account of the silvery hairs which deck the seeds, or because, when the seeds have been scattered by the wind, the bald receptacle is so prominent through the subsidence of the divisions of the calyx.

The alleged medicinal virtues of this plant are very numerous. Withering informs us that a strong infusion of Groundsel will occasion vomiting. He also tells us that the bruised leaves of the plant form a healing application to boils, and that one species of *Senecio* is recommended as a remedy for the terrible disease of Cancer. Surprising cures are stated to follow an application of bruised leaves in most severe cases of sciatica, etc. *S. Saracenicus* is said to have derived its specific name from the fact that the Saracens used the plant for the purpose of curing their wounds.

In regard to its dietetic properties, none of the species are esculent. Withering tells us the brute creation have very mingled

feelings in regard to its savoury character. Cows are reputed to eat it, although they do not consider it a luxury. Goats and swine eat it, whilst sheep refuse it. To the feathered race, however, it is a choice morsel.

> "I love to see the little goldfinch pluck
> The groundsel's feathered seeds, and twit and twit,
> And soon in bower of apple-blossom perched,
> Trim his gay suit, and pay us with a song."

One of the British species of Ragwort (*S. Jacobæa*) is said to afford a good and permanent yellow dye for woollen goods.

Having thus briefly sketched the habits and utility of the genus, we will now confine our attention to the common species of Groundsel, *Senecio vulgaris*.

The seeds are of extreme beauty, each plume bearing a single seed. Their number is very great. A single plant may produce from 120 to 130 flowers, and each flower from 50 to 60 seeds. This wonderful fertility provides for all losses, whether by tillage or by the depredations of insects, birds, or cattle. Linnæus calculated that an annual, producing only two seeds in the year, would, if unchecked, establish a million plants in twenty years. What, then, would be the increase of a plant which produces 6,500 seeds in one season? Darwin, in his "Origin of Species," relates an experiment to prove the destruction of seedling plants by slugs and insects. On a piece of ground 3 feet long and 2 feet wide, dug and cleared for the purpose, he marked and counted all the seedlings of our native plants as they made their appearance, and out of 357 so marked, 295 were destroyed. The rich harvests of Groundsel every year arise, therefore, from the immense seed-bearing properties of these plants. But there is yet another powerful agent at work to prevent the extirpation of the species, and this is self-fertilisation, and by this I simply mean fertilisation without the aid of wind or insects. There is also a system of cross-fertilisation, which will be explained presently.

From the fact of the flowers of Groundsel having no rays, Sir John Lubbock infers that it is rarely visited by insects. It does not, therefore, depend, as do many others, upon the exchange of pollen between several plants. Were it to depend on this, the fact of its being in a great measure unvisited by insects

would be a serious impediment to its increase. Mr. Darwin, in the same chapter to which I have already referred, instances a plant of *Lobelia fulgens* in his garden, which absolutely will not produce seed unless visited by insects; but as in his locality he knows it is not so visited, he compromises the matter, and insures his seedlings by crossing the pollen with his own hands. He dwells further upon the mutual checks to increase, remarking that plants and animals are bound together by a web of complex relationship. He believes that the Heart's-ease (*Viola tricolor*) and the Red Clover (*Trifolium pratense*) are wholly dependent for their existence upon the visits of Humble-Bees, other bees not visiting these flowers. If the Humble-Bee became extinct, he believes that these plants would become extinct also.

Now, the Humble-Bees increase or decrease in inverse proportion to the number of field-mice found in the same district, as these animals destroy their nests and combs: one naturalist affirms that throughout England two-thirds of the Humble-Bees are thus destroyed: and, lastly, the number of field-mice depends on the number of cats. The same naturalist affirms that near villages and towns the number of Humble-Bees is greater than in the open country, because the cats (as we in Bath know by painful experience) are more numerous. Darwin, therefore, adds—"It is quite credible that the presence of feline animals in large numbers in a district might determine, through the intervention, first of mice, and then of bees, the frequency of certain flowers in that district." Hence the peculiar self-fertilising character of the flowers of *Senecio vulgaris* is an additional cause for the favourable increase of the plant.

To recapitulate, then, we have three very important causes which prevent the extinction of the Groundsel:—

1.—Parachute, or "plumed" seeds, which insure distribution.

2.—Vast seed-bearing qualities.

3.—Self-fertilisation, which renders the plant indifferent to the visits of insects.

As to the dissemination of these plumed seeds by the agency of the wind, Mr. H. J. Slack, in his paper on "Plant-Hairs," in *Science for All*, narrates an interesting fact which came under his own observation. When looking through an astronomical tele-

scope in a particular direction, the sky seemed to swarm with pale, glittering, falling bodies, like a miniature shower of meteors, and he came to the conclusion that they were the plumed seeds of one of the Composite plants, probably those of the thistle, glancing in the sun-beams.

The hairs of the corona, or "plume" of the common Groundsel are very transparent, and are composed of oblong and tolerably regular cells, apparently filled with air. They are very thorn-like, and have longitudinal markings upon them, which are probably grooves (Plate 26, Fig. 2).

The oblong, cylindrical seed-vessel, called in botanical language the *Achænium*, is, when mature, of a rich brown colour, and has several rows of minute silvery hairs upon its surface. The upper portion is formed into a ring-like tissue, from which the corona of hairs springs. In the drawing, Plate 26, Fig. 1, I have purposely left one-half of this ring destitute of plumes, that the appearance may be better understood.

In regard to the short silvery hairs of the achænia, the *Micrographic Dictionary* refers to their interesting character, in that when brought into contact with water they emit spiral fibres. In the *Annals of Natural History* for 1841, the same character is referred to. The seeds should be quite mature, and must be gathered before dew or rain has visited them. I have witnessed this curious process in seeds which have been matured under home protection, and the drawing, Fig. 3, is made from a camera-lucida drawing immediately after the bursting-forth of the spiral fibre. The experiment is a very delicate one, owing to the minute character of the hairs. The hairs, when moistened with water, appear to divide themselves into two portions, and from each longitudinal half, a fibre, rather indistinctly spiral, protrudes from the apex of each division, or if the hairs are broken, is propelled through the fracture, and sometimes from the base of the hairs. During the propulsion of this fibre, the detached hairs are vigorously swayed to and fro, apparently in consequence of the internal force which accompanies the emission, the stream of tissue rapidly moves from base to apex, and extends to two or three times the length of the individual hair. The same phenomenon is met with in a few other plant-hairs, but I have not at present been able to solve the pro-

blem as to the reason of this remarkable provision. Probably the fibres serve in securing the seed to the earth, when it has been wafted thither by the agency of the wind.

Another interesting fact in connection with the seeds is the number of raphides and other crystals contained in the cuticle of the unripened germ, and subsequently in the testa of the seed. These, when mounted as a microscopic slide, present a very beautiful appearance under polarised light. They are represented in Plate 27, Figs. 4 and 5.

The roots of *Senecio vulgaris* are very branching, of silvery whiteness, and are densely covered with fine hairs. The large number of branchlets and their hair-like appendages enable the plant to take a firm hold upon the surrounding soil, and it is far easier to break the plant short off from the earth than to draw it out with the roots entire. The rootlet tip is well figured by Mr. Lett in Plate XII., Fig. 7, of this volume.*

The stem of *Senecio vulgaris* is irregularly cylindrical, having very few hairs upon it; it is sometimes of a reddish brown, and sometimes of a uniform green colour. The more mature stems are hollow, but in certain earlier stages they are filled with a pith-like structure composed of pentagonal and hexagonal cells. My own sections show internal cells larger than those figured by Mr. Lett in Plate XII., Fig. 2; but he has very clearly shown the fibro-vascular bundles.

The leaves of this plant are winged, indented, alternate, and clasping the stem; they are sparingly covered with long, silky hairs. The mid-rib is prominent, and forms a keel-like structure at its union with the stem. The upper surface of the leaf is dark green, and slightly rough, with many minute protuberances, and the cuticle adheres so closely that it cannot be detached without stripping away with it the dense masses of chlorophyll which fill the internal portion of the leaf. The underside of the leaf is of a lighter shade, almost approaching to a greyish tint, and its cuticle can be more readily detached. On this under cuticle the stomata are numerous, but very minute, and although not readily distinguishable they may be well seen if the cuticle is stained and examined with the spot-lens. Mr. Lett has given a faithful drawing of this cuticle (Pl. XII., Fig. 6).

* See "A Bit of Groundsel," p. 101.

The leaves appear to be destitute of raphides, but the cells apparently contain large quantities of very minute starch-grains. In some of the leaves I have also detected some large discs of a substance which I take to be Inuline (Fig. 6, under polarised light).

Inuline is closely related to starch and sugar, and, according to Sachs, is very abundant in the cell-sap of the Compositæ, and may be readily developed by the application of alcohol, when it will be detected in large masses of a spherical crystalline structure, which under polarised light appear very similar to the crystals of Oxalurate of Ammonia, showing a distinct cross with its point of divergence exactly in the centre of each sphere. As in my experiments all the leaf-sections, as well as the whole leaves, have been prepared in alcohol, I venture to suggest that these beautiful polarising discs are most probably inuline.

The floral structure of the Groundsel must now claim our attention. The flowers are in clusters surrounding the stem of the plant, and each composite head is situated upon a floral stem. To an ordinary observer there is nothing attractive in the small green capsules with bulging bases and black, pointed calyx-scales; and were it not for the bright yellow adornment above them, tipping as with richest gold the long green caskets, many persons would scarcely recognise any flowers at all. But within them lies a rich and varied store of creative skill and adaptation, and we are compelled to use lens, needle, and scalpel to assist us in the elucidation.

The "involucre," or green cup, which encloses all the florets is composed of sixteen or seventeen sepals or bracts. The involucre is double, and has smaller bracts at its base; the longer bracts tightly enclose the "capitulum," or head of florets attached to the receptacle, and on the seeds becoming mature they unclasp and fall downwards below the receptacle, but they still remain attached. By mounting several of them, both stained and unstained, we discover that the apex of each, which when in growth is almost black in colour, shows a pretty fringe of membrane when examined under polarised light (Fig. 7). This involucre is the calyx described by Withering and all old botanists.

The calyx proper is that which surrounds each floret, and in the case of the Groundsel, Dandelion, and Thistle, is really the

plume attached to the germen, and for this reason it answers to the description of a superior calyx, and remains attached to the mature seed. Instead of the term calyx for this part of the flower, modern botanists have named it the "pappus."

We now pass on to a description of the florets. These, as I have said, are all tubular; no strap-shaped ray-florets are found, as in the daisy. Each floret is hermaphrodite, containing both pistil and stamens. Much time and patience are required to open the tubes, owing to their minute character, but unless this is done, it is quite impossible to understand the structure of the reproductive organs.

The florets are monopetalous, each petal having five clefts, and there are from fifty to sixty petals in the capitulum. Each floret possesses five stamens and one pistil. The five stamens form themselves into a tube within the corolla, through which the pistil pushes forward its head. The stamens and filaments are quite distinct, the latter growing from the base of the corolla, and the former cohering with close embrace.

The pollen-grains lie upon the inner faces of the stamens, and as the pistil grows upward through the pollen-lined tube, the grains of farina are pushed upwards towards the top of the corolla, and when the pistil protrudes itself, the fine and delicate hairs with which it is furnished are loaded with pollen-grains. By studying the drawing (Fig. 8), the system of fertilisation in the Groundsel may be readily understood. In floret *A*, the interior of the corolla is laid bare, in order that the syngenesious character of the stamens may be observed. The pistil, as it passes through the tube of stamens, appears as a cylindrical organ with a hairy, thickened summit. So soon as it has passed the tube, the summit loaded with pollen separates into two parts, until, as in floret *B*, it appears with two widely-extended arms, each one bearing at its extremity a brush-like appendage studded with pollen-grains. In floret *C*, the summit is still more advanced, and the pollen-grains at the extremities have disappeared. But although we here have a system of *self*-fertilisation in each plant, there is a wonderful system of *cross*-fertilisation carried on between the floret of each capitulum. The pollen of floret *A* does not fertilise the pistil of *A*, and the like negation belongs to florets *B* and *C;* there is an

interchange of reproductive agency. If we examine the capitulum with a pocket-lens, we shall observe that in some of the florets the pistils have protruded, whilst in others they are still lying in the close embrace of the stamens. In fact, the pistils and stamens of each floret do not mature simultaneously. The cloven summits of florets *A* and *B* are not ready to be impregnated with the pollen they have been bearing aloft; they are simply carrying the pollen-grains to fertilise the stigma of floret *C*. The pistil of floret *C* has previously risen and scattered its pollen-grains on the already matured stigmas of other florets; and so the pollen-grains of floret *B* fall upon the matured stigma of floret *C*, and impregnation ensues.

The upper surfaces of the summits of the pistils are alone stigmatic; that is, they are furnished with the viscid substance which causes the pollen-tubes to grow, and pass down the style to fertilise the contents of the ovary.

The study of this very common wild flower has well repaid me for the time spent upon it—and none of our readers need be at a loss to find microscopical profit and pleasure—if he will only take up one of our commonest weeds, and work out, with the aid of the microscope, its life-history; let him not perplex himself by hunting up all the literature that may have been written on the subject, but take pocket-lens and needles, and set to work. Mount as microscopical objects every conceivable portion, and by the aid of the camera lucida make careful and accurate drawings of the same. He will then be able to say with Coleridge :—

> "Nature ne'er deserts the wise and pure;
> No plot so narrow, be but Nature there;
> No waste so vacant, but may well employ
> Each faculty of sense, and keep the heart
> Awake to love and beauty."

EXPLANATION OF PLATES XXVI. AND XXVII.

PLATE XXVI.

SENECIO VULGARIS.

Fig. 1.—Seed divested of half its plume, × 20.
,, 2.—Hairs of plume, × 240.
,, 3.—Hairs of Achænium, with spiral fibres, × 240.

PLATE XXVII.

,, 4.—Section of Germen, with Raphides *in situ*, × 240.
,, 5.—Section of Testa, with ditto, × 50.
,, 6.—Section of Leaf, with Inuline Crystals, × 240.
,, 7.—Apex of Bract, × 54.
,, 8.—Florets to explain Cross-Fertilisation, × 12.

Half-an-Hour at the Microscope,

With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

Black-ground illumination is a poor way of getting at the facts which a specimen may disclose; so also is polarising. An examination should be commenced with the lowest power likely to be suitable; then higher and higher powers applied, when probably at each step new facts will be discovered—*i.e.*, if the object be not spoilt by being mounted merely with the intention of looking pretty. Our object should be to see things *as exactly as possible as they are in life*. Crushing an object with spring clips is diametrically opposed to this, and should be in a general way avoided. Use potash in the preparation of an insect if needful, but if you do, try to get it into its natural form afterwards. Don't think that perfection is to get things as painfully flat as possible—that is the most unlike nature that can be.

Seeds, Paulownia imperialis.—This furnishes one of the most beautiful objects for displaying the powers of the binocular microscope which I know. The pleasing effect of these exquisitely delicate lace-like wings is very great. The natural order, SCROPHULARIACEÆ, to which the plant belongs, furnishes very

many seeds of interest to the microscopist. Those of *Nemesia* especially should be studied in connection with the present specimen; as well as the seeds of *Lophospermum*, *Maurandaya*, the Antirrhinums, Foxgloves, Mullens, Eye-Bright, *Bartsia*, etc. And the closely allied order, BIGNONIACEÆ, has for one of its distinctive characters, "seeds winged," and furnishes magnificent examples of the structure. Fancy a seed an inch across, with a wing of the same width all round! Such is *Calosanthes indica*. *Eccremoscarpus scaber* is a well-known plant, having a winged seed approaching to the latter in structure. This (structure) is caused by the undue development (according to law) of some of the cells composing the testa over others. It has been well described by H. B. Brady in "The Quar. Jour. of Micro. Science" (Transactions) for July, 1861, p. 65, Pl. VII.

The name is differently spelt by different authorities. Lindley gives it as *Paulownia*, and this is what I have always been used to; but I find Henfrey, in his "Elementary Course of Botany," has two "l's," thus, *Paullownia*.

Spicules of Grantia compressa.—There are seven British species of *Grantia* described. One of their characters is to have the spicula calcareous, instead of siliceous, as in most other sponges, hence readily soluble in dilute acids. *Grantia compressa* has a classic interest, from its being the form in which Dr. Grant first discovered "inhalation" and "exhalation," the vital action of the sponge, and so settled the controversy as to the SPONGIDÆ being truly animal, and not vegetable, as many had supposed, from their peculiar inertness and vegetable-like mode of growth. Bowerbank followed up these researches on "Ciliary Action in the *Spongiidæ*," by a paper published in the "Transactions of the Microscopical Society," Vol. III., p. 137, and it is to him that we owe most of our knowledge of the wonderful elaborateness of design in most of the sponges, with spicules of differing forms, according to the varying purposes of the animal economy: some for building up the framework, others for purposes of protection or defence, and yet others of a third order to bind those named together. The tri-radiate spicula, however modified by size and form, are essentially *skeleton spicula;* while the simple acerate form appertains more especially to the defences of the animal. (Bowerbank on "Grantia Ciliata" in "Quar. Journ. of Micro. Science," July, 1859 (Transactions), pp. 79—84). A paper of unusual interest, to which I would refer all who desire to follow up the subject.

Bugula avicularia.—Examples may be mounted with the polypes fully expanded by *dropping* gin carefully and slowly into a

small vessel containing the living specimen in sea-water, observing to do so when the polypes are *fully expanded.* This intoxicates them; they die in their extruded condition, and can be removed and mounted. The "Bird's-head" processes are remarkable organs, which during life are continually moved upwards and downwards with the regularity of a pendulum. Their structure and nature have been carefully investigated by Prof. Busk. A powerful abductor muscle closes the beak; a small abductor opens it. These are of striped, voluntary fibre. The centre of the "head" is occupied by a body, which appears to be "ganglionic," and when the beak is widely opened a bunch of tactile hairs is exposed.

Ophiocoma neglecta is a highly interesting object. Note the circlet of five didactyle pedicellaria, round the mouth-opening, and the corona of them on the hard parts surrounding where the soft inner structures commence; also the curious claws on the under-surface of the rays. W. B. Herapath, in the *Quar. Jour. Micro. Sci.*, 1865, pp. 175—184, may be consulted with advantage in Pedicellaria; and G. Hodge, in *Trans. Tyneside Naturalists' Field Club*, has a valuable paper on the development of *Ophiocoma rosula*, with a special view to these hooks, which he states to be peculiar to the young Brittle Stars, and to be afterwards *modified* into spines by a process which he fully describes, pp. 42—48, and note on p. 64. Members residing near the seaside would do well to *confirm and extend* these observations.

Helix aspersa, Eggshell of.—A valuable contribution to our knowledge, and quite original. To extend these remarks to the eggs of other Helices and Gasteropods generally would be nice work for our members. Has the action of acid been tried on these crystals? Some members seem to have very vague notions of the formation of shells; these should read carefully Carpenter's contributions to knowledge on the subject in his *Microscope* and *Trans. of the Brit. Association;* also Bowerbank. Rainey, "On the Formation of Shell and other Hard Structures," in *Quarterly Jour. Micro. Sci.*, republished *in extenso* by Churchill, must be carefully studied. He was a splendid worker.

Tracheæ of Scolopendra has been coloured apparently by magenta, to make it look pretty, some would say; to show the parts more distinctly, would be the verdict of others. This would be more instructive if not pressed flat; the specimen does not profess to show the spiracle, the most interesting part of it in reality. A portion of it is, however, there, and enabled me this morning to confirm the correctness of the name by examining the spiracle in the specimen of the "Great West Indian *Scolopendra*

morsitans, whence, no doubt, this came. The large size of the tracheæ is noteworthy, and I think, so far as my examination extended, the fibre appeared to cease in the tubes much earlier than usual.

B. T. Lowne speaks of its being visible in the Blow-Fly (*Musca vomitoria*) in tubes down to the calibre of 1—10,000th of an inch (*Anat. and Physiology of Blow-Fly*, p. 26). Mr. Lubbock has some important remarks on "Tracheal Tubes" in the *Linn. Trans.* of some 10 or 12 years ago.

Lipeurus baculus (Plate 28, Figs. 1—5).—So far as I have had the opportunity of ascertaining, I believe that all the bird-pediculi *feed on the feathers*, with which their stomachs may at times be found to be *crammed.*

Reference to H. Denny's "*Monographia Anoplurorum Britanniæ*" would teach at once that the present specimen is a male. It will be advantageous to compare the hooked antennæ of this species with other examples found in bird-lice, and these with corresponding structures in spiders and many crustacea. Feet are not well shown in the slide. Spiracles exceedingly small. I think there are twelve on each side. Note the mouth-organs. The true homologues of them offer an interesting problem for solution. The long terminal hairs have undoubtedly important functions to discharge of a sensory nature, and may be well compared with the tails of crickets and other orthoptera. I think Shakespeare has an interesting allusion to the important uses of the anal setæ in the cricket, but have not time to turn it up just now.

The bird-lice have not such "sharp claws for adhering to the skin." "Their mode of progression is rather singular as well as rapid. They slide, as it were, sideways, extremely quick, from one side of a fibre of the feather to the other, and move equally well in a forward or retrograde direction." (Note here the beautiful adaptation of the limbs for such use), "which, together with their flat, polished bodies, renders them extremely difficult to catch or hold."—(*Mon. Anop. Brit., p. 166*, sub. *L. Polytrapezius.*)

This description is highly graphic. The lice of the common fowl (*Menopon pallidum*) are sometimes very numerous, and then become a great plague to those who have to pluck the birds, irritating excessively by running over the skin, though in a few hours they die for want of proper food.

Denny says of *L. Baculus*:—"I find this species very common on all varieties of pigeons, and living in society with *Nirmus claviformis* and *Goniocotes compar.* Few birds, indeed, are so infested with parasites as the *Columbidæ.* Besides four species of lice, I have found a large Ixodes, a small Acarus, and the *Pulex Columbæ;* and the Rev. L. Jenyns has detected a bug, *Cimex*

Columbarius, described by him in the "*Annals of Natural History*," Vol. 5, p. 242, which has also occurred in Dovecotes, near Leeds (*Mon. Anop. Brit.*, p. 173).

Here is interesting work for the microscopist indeed. I do hope some of our members may be induced to take it up, and will favour us by "*passing them round.*"

The only specimen I have of this species was taken off a pigeon which fell dead (shot, probably) in the little garden attached to the house I was then residing at, in Queen's Road, Dalston, now some 30 years ago. I just mention this as some little encouragement to those who have to work under difficulties, as, it must be admitted, Londoners have in some respects.

Pupa-case of Ephemeron.—The slide I myself enclose is illustrative of one stage in the *metamorphosis of a small species of Ephemera*, or May-fly. These occur in myriads for a portion of the summer near two large sheets of water, called, in the homely phrase of the place, "Frensham Great Pond" and "Frensham Little Pond." They are favoured resorts of many aquatic insects. A person walking near these lakes when the insects in question are coming out, may find him or herself quickly covered with the small May-flies, which settle, remain tolerably quiescent for a time, then wriggle out of their old suit of clothes, and fly away in a brand new one. A graphic description of the process will be found in *Westwood's* "*Introduction to the Modern Classification of Insects*," vol. 2, p. 27, and in a foot-note a discussion of the nature of the metamorphosis.

A discussion of the matter, specially as a microscopic study, by the present writer, will be found in the "*Transaction of the Micro. Soc. of London*," Vol. for 1866, pp. 69, 70, and Pl. VII., and J. W. Lubbock has discussed it in *Clocon dimidiatum*, in the pages of the Linnean Transactions.

TUFFEN WEST.

Sting of Scorpion.—I read with interest Tuffen West's remarks about this and the oxalic acid crystals, or isomeric crystals. He suggests that "the fangs of Poison Serpents might be expected to yield similar crystals."

Some years since, when examining the structure of sections of teeth-dentine and enamel by polarised light, my brother, F. H. Balkwill, supplied me with a poison-fang of a viper; this I proceeded to make a section of, in the course of which I observed that it was a tube with a small oval aperture, near or at the apex, I think the former, and that it was filled with semi-transparent, sub-quadrangular, or cubical granules. Unfortunately, I carried

the grinding operation too far, and just rubbed off the point of the tooth with its aperture, so that the opening now to be seen is merely a slightly transverse or oblique section of the tube; however, it displays the structure of the tooth and the full stream of granules by which it is filled. For obvious reasons I did not attempt grinding the opposite side of the tooth, as this would probably have caused the loss of the granules. On examination by the $\frac{1}{4}$-in. object-glass, it will be found that these lie superposed, several thicknesses of granules in depth. Somewhat crystalline, they appear less sharply angular than well defined crystals, and not much longer than broad, as in the ordinary oxalic and prismatic crsytals. They look like crystalline stones, and may have become rounded by friction. I enclose the slide for examination.

F. P. BALKWILL.

EXPLANATION OF PLATE XXVIII.

Fig. 1.—Lipeurus Baculus (Pigeon-Louse).
,, 2.—Antennæ of ♀.
,, 3.—Posterior leg.
,, 4.—Antennæ of ♂.
,, 5.—Anterior leg.

After Denny.

,, 6.—Outline sketch of the Fang of a Viper, × 25.
,, 7.—Portion of same, showing crystals of poison, *in situ*, × 150.

Drawn by Miss B. Bryant.

Reviews.

YEAR-BOOK OF THE SCIENTIFIC AND LEARNED SOCIETIES OF GREAT BRITAIN AND IRELAND, giving an account of their Origin, Constitution, and Working. Compiled from official sources. With Appendix, comprising a list of the Leading Scientific Societies throughout the world. (*London: Chas. Griffin and Co.* 1884.)

We have for years felt the urgent need for such a work as the present. The receipt, therefore, of the first annual issue of this work gives us much pleasure.

The book is arranged in 15 divisions, embracing the following sections, viz. :—1.—SCIENCE GENERALLY; *i.e.*, Societies occupying themselves with several branches of Science, or with Science and literature jointly. 2.—Mathematics and Physics. 3.—Chemistry and Photography. 4.—Geology, Geography, and Mineralogy. 5.—Biology, including Microscopy and Anthropology. 6.—Economic Science and Statistics. 7.—Mechanical Science and Architecture. 8.—Naval and Military Science. 9.—Agriculture and Horticulture. 10.—Law. 11.—Medicine. 12.—Literature. 13.—Psychology. 14.—Archæology. 15.—Foreign Societies. Under the first fourteen sections will be found accounts of more than five hundred Societies actually engaged in original research in the United Kingdom. The 15th section comprises a list of over 1,400 scientific bodies prosecuting their studies in foreign countries.

From the care taken by the compilers to secure particulars respecting our own little Society, we have no hesitation in stating that we believe every precaution has been taken to ensure accuracy.

PLANT-LIFE. Popular Papers on the Phenomena of Botany, by Edward Step, author of "Easy Lessons in Botany," etc. Third edition. (*London: T. Fisher Unwin.*)

This book, written in a very popular style, contains chapters on Microscopic Plants, Plant Structure and Growth, The Fertilisation of Flowers, Predatory Plants, Remarkable Leaves, About a Fern, The Folk-Lore of Plants, Plants and Animals, About Mosses and Lichens, Plants and Planets, About Horsetails, Stoneworts, and Pepperworts, The Falling Leaf, About Fungi, Algæ, to which is added as an Appendix, a Table of the Cryptogamia or Flowerless Plants.

The work contains 156 illustrations by the author, but we are compelled to suppose that they were not engraved for the present work, as we find that no notice is taken in the text of a great number of reference-letters by which the engravings are supposed to be explained. There is a chapter on Plants and Planets and Plant Folk-Lore, which tells much of the strange beliefs of an inexact and superstitious age.

GEOLOGICAL RAMBLES ROUND LONDON, with 25 illustrations and sketch-maps. (*London: T. Fisher Unwin.*)

This is one of the "Half-Holiday Handbooks," and contains in a compact form a great deal of information in reference to Old-World London, the object of the work being to condense into a small compass some description of the geological features of

London and its immediate neighbourhood. For this purpose, the area has been narrowed to allow of all the sections mentioned being easily visited by the London half-holiday maker during the Saturday afternoons of one summer.

The other works of this series are also of a very interesting nature.

Elements of Histology. By E. Klein, M.D., F.R.S., etc. Third edition. (*London: Cassell and Co.* 1884.)

This is one of the very useful "Manuals for Medical Students," to whom, from its convenient size and compact form, it is very suited to form a pocket companion. For easy reference, each important paragraph (upwards of five hundred) are numbered. The work also is illustrated with 181 well-executed engravings.

We can confidently recommend this valuable little manual to the notice of all our readers who are students of Animal Histology. The well-known repute of its author, Dr. Klein, is, we venture to think, a sufficient guarantee for its excellence, and renders any further notice of the work on our part unnecessary.

We have received from C. Henry Kain, Esq., Camden, N.J., U.S. America, a Photographic copy, on the reduced scale of one-half diameter, of the very important "Atlas der Diatomageenkunde In verbindung mit den Herren Gründler, Grunow, Janisch, Weissflog und Witt, Herausgegeben von Adolf Schmidt."

Mr. Kain tells us he was induced to make a Ferro-prusiate copy of this work for his own use. He has since supplied as a special favour copies to several of his friends, and has only a few now remaining on hand. The style of the blue print is, of course, not to be compared to the beauty and clearness of the original plates, but they are sufficiently distinct to enable the microscopist to identify any of the forms represented.

The copy now before us consists of 40 pages of letterpress and 80 plates, all in Blue Photography.

The Desmids of the United States, and List of American Pediastrums, with eleven hundred illustrations on fifty-three coloured plates. By the Rev. Francis Wolle, Member of the American Society of Microscopists, Bethlehem, P.A. (U.S.A.), 1884. (*London: W. P. Collins, 157, Great Portland Street.*)

This magnificent work on the Desmidiaceæ of the United States contains, besides the fifty-three plates (each of which is accompanied on the opposite page by a descriptive cata-

logue, giving names of species represented, magnification, etc.), nearly two hundred pages of descriptive letterpress. In these we have first a list of authors consulted, followed by a few pages of preliminary remarks on the Algæ, to which is added instructions on "How to Find, How to Collect, and How to Preserve Fresh-Water Algæ." The author next confines his attention to the Desmid group, describing their methods of multiplication—1st, by cell-division and growth; 2nd, by sexual intervention or regeneration. The major portion of the letterpress is, of course, taken up with a full and careful description of all the genera and species represented. This is followed by an index to some 500 or more species.

Although the work is believed to be exhaustive of all now known concerning the Desmids of the United States, yet the author regards it only as the pioneer to others much larger, and therefore more valuable, wherein will be recorded the achievements of those who will, perhaps, be indebted to this work for their first introduction to so fascinating a study as that of the fresh-water *Algæ.*

The whole work is beautifully printed on good paper, royal 8vo size. The plates also are well drawn and coloured. It is unquestionably the best work of the kind we have seen.

THE STUDENT'S GUIDE TO SYSTEMATIC BOTANY, including the Classification of Plants and Descriptive Botany. By Robert Bentley, F.L.S., M.R.C.S.Eng. (*London: J. and A. Churchill.* 1884.)

This little work, we learn by the preface, is intended to form a supplement to "The Student's Guide to Structural, Morphological, and Physiological Botany," which was published by the same author a year ago, and being well adapted for carrying in the coat-pocket will form a very agreeable travelling companion to the botanical student.

The first and by far the greater portion of the work (137 pp.) is taken up with the Classification of Plants, in which is considered first the General Principles of Classification; second, the various Systems of Classification; and third, the Arrangement and Characters of the Natural Orders. The remaining portion of the book is devoted to Descriptive Botany. Here we have two chapters, the first of which gives Directions for Describing Plants, embracing the Means for Observing them and General Rules for their Examination; and next, Instructions for the Examination of the Special Organs and Parts of Plants, with a List of the Abbreviations and Symbols used in botanical works. The second chapter

contains full descriptions of nineteen important Medicinal plants which are all common either in a wild or cultivated state in Britain, and may therefore be readily obtained for examination.

We heartily agree with the author in believing "that the present work cannot but form a most convenient and handy little volume for use abroad and at home by medical, pharmaceutical, and all other students who are desirous of obtaining a good practical knowledge of some of the more important British natural orders and their medicinal plants, and also as a foundation for further study. The first portion of the work is illustrated by 357 engravings.

THE ILLUSTRATED SCIENCE MONTHLY, a Popular Magazine of Knowledge, Research, Travel, and Invention. Edited by J. A. Westwood Oliver. (*London: David Bogue.*)

It is almost sufficient to read the headings of the articles in the three numbers before us, with the names of the authors appended, to judge of their value and the extent of ground occupied by them. We have read several of these articles with much interest. The illustrations are well drawn and clearly explained. If any objection is to be found, it belongs to the astronomical maps, which, with their rhomboidal and triangular shaped stars, seem only to confuse and to mislead instead of making the various magnitudes plain to the reader. We might also add that the Rev. J. G. Wood has been too long accepted as an accurate naturalist to deserve any doubt of his statements of the occasional strange tricks and doings of pet animals. With this exception, we like the periodical extremely, and wish it much success.

A NEW AND EASY METHOD OF STUDYING BRITISH WILD FLOWERS BY NATURAL ANALYSIS: being a complete series of illustrations of their Natural Orders and Genera analytically arranged. By Frederick A. Messer. (*London: David Bogue.*)

That illustration is a more powerful as well as a more alluring and ready means of imparting knowledge than letterpress by itself will not be doubted. This pictorial method resembles more closely than any other that which is naturally followed in the comparative examination of the parts of the plants themselves.

This book, which will be found a most useful work by all botanists, commences by giving a very full glossary of botanical terms; then follows a list of symbolic illustrations, abbreviations, etc., also a list of the natural orders of Flowering and Flowerless Plants; after which the true object of the book is heartily entered into, not only the various classes of the Vegetable kingdom, but

each genera being diagrammatically illustrated. The book concludes with a chart, showing at one view the number of species of plants in each order, a catalogue of British plants, and two full indexes: one of orders and genera, the other of English names.

THE METHODS OF MICROSCOPICAL RESEARCH. STUDIES IN MICROSCOPICAL SCIENCE. POPULAR MICROSCOPICAL STUDIES. Edited by A. C. Cole.

This excellent series, which has been received at regularly alternate weekly intervals, is, we much regret to hear, now brought to a termination. We look upon these handsome volumes with much pleasure, the coloured lithographic plates throughout the whole series being of a very high class. The slides accompanying each part have always been of the excellence for which all Mr. Cole's productions are so well known.

The information conveyed in the "Methods of Microscopical Research" is invaluable to the practical microscopist, and all non-subscribing microscopists should take an early opportunity of securing the bound volumes, which are now being offered by Mr. Cole.

THE SAGACITY AND MORALITY OF PLANTS: A Sketch of the Life and Conduct of the Vegetable Kingdom. By J. E. Taylor, Ph.D., F.L.S., F.G.S., etc. With coloured frontispiece and 100 illustrations. *(Chatto and Windus, Piccadilly.* 1884.)

This book is written in a novel and extremely interesting style. The attributing to members of the vegetable kingdom contrivances and instinct and thought which hitherto have been spoken of as pertaining to the animal kingdom alone, is not only novel, but also serves to render more attractive the contents of the book. Those contents are very well arranged, and the style is so clear that few will fail to understand and to profit by its perusal. We have very great pleasure in recommending the book.

WHENCE? WHAT? WHERE? A View of the Nature, Origin, and Destiny of Man, by James R. Nichols, M.D., A.M. Seventh edition. *(Boston, U.S.A.: Cupples, Upham, and Co.* 1884.)

This very remarkable book is well worthy of careful reading; it is written in a good, comprehensive style, will be found to induce much thought, and in it we think Dr. Nichols clearly establishes the fact that science and religion are not necessarily opposed. We are asked by the publishers to state that a copy (in paper covers) of "Whence? What? Where?" will be presented to every new annual subscriber to the *Popular Science News.*

Popular Science News and Boston Journal of Chemistry. (*Boston, U.S.A.*) August, 1884.

This is a popular journal, and all its articles are plainly written. Its design appears to be to furnish in a compact form, and at a low price, the new facts in science, mechanics, art, invention, agriculture, and medicine, which it is desirable should be widely disseminated among reading people.

Current Notes and Memoranda.

The Naturalist's World continues to give a series of interesting papers. The September number contains the concluding part of a paper on "The Preparation of Rock-Sections for the Microscope," etc. etc.

The Microscopical News for September has good articles on Weevils, Some Free-swimming Rotifers, Bacteria, etc.

The July part of The Journal of the Quekett Microscopical Club commences the second volume of the second series. It is an excellent number, containing good articles on "An Undescribed Species of Myobia; On the Hexactinellidæ; On some New Diatoms from the Stomachs of Japanese Oysters; Notes on Mermis Nigrescens; A long List of Objects obtained at some of the Excursions; Proceedings of the Meetings held in April, May, and June, and is illustrated with four well-executed lithographic plates.

Science Record (Boston. U.S.A.) supplies a large amount of interesting matter. The part for August 15th has papers on The Origin of Vertebrates; Sea-Cucumbers (with several illustrations); Microscopical Technique at Naples in 1883 (part 4), and other papers.

The American Naturalist is at all times acceptable; many of the articles in the September part are of exceptional interest. Our space will only allow us to notice one or two. Of these the

chapters on The Northernmost Inhabitants of the Earth (with 21 illustrations), and On the Condylarthra (continued from August part, with 28 engravings and 3 plates) are deserving special attention. The "General Notes," which form an important item in each issue, are of much value.

THE JOURNAL OF SCIENCE and Annals of Astronomy, Biology, Geology, Industrial Arts, Manufactures, and Technology; as its title implies, covers a large range of subjects. Our general readers will find every article more or less to their tastes.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL for August contains the following amongst a series of good papers:—Growing Slides, or Microscopical Vivaria; Rapid Method of making Bone and Teeth-Sections; Pond-Life in Winter; Microscopical Technic, etc.

THE MICROSCOPE for August continues its joke about the "Fakir's Secret," and tells us how to produce "Paste Eels"; Studies in Histology, Lesson 5, is on Metallic Stains and Mounting; A New Solid Watch-Glass is described, to be used as a staining or dissecting dish, etc. etc.

COTTON, WOOL, AND IRON comes to us with great punctuality. We are glad to notice that the editor of this Journal, as well as the editor of another important Journal—THE AMERICAN JOURNAL OF FABRICS—are directing their attention, in real earnest, to the microscopical examination of fabrics. In addition to the purely technical articles we naturally look for in such journals, there is an abundance of interesting matter.

Apropos of our article in the current part on the "Preparation and Mounting of Diatoms," we have received from Mr. C. Henry Kain a double slide of *Navicula rhomboides*, the diatoms under one cover-glass being mounted in Canada Balsam, those under the other in Balsam of Tolu. We are struck with the extra clearness of the Tolu mount, although the medium is not nearly so colourless as the Balsam. Mr. Kain does not give us the formula for preparing the medium.

Van Nostrand's ENGINEERING MAGAZINE for September (New York, U.S.A.) contains, in addition to a large amount of informa-

tion specially valuable to the engineer, several articles of general interest—"The Temperature of the Sun," "The Meteorology of the Great Pyramid," and several others.

We have pleasure in drawing the attention of our readers to PEASE'S "FACILITY" NOSE-PIECE, an engraving of which we annex. This appliance has been devised to facilitate the rapid interchange of objectives. The adapter nose-piece, A, screws on to the nose-piece of the microscope by the usual society screw, where it may remain permanently. It is provided with mechanism similar to that applied in the self-centering chuck. By the partial

rotation of the milled collar, three sections of a flat spiral are made to act upon three sprung steel teeth, causing them to project from slots within the cylinder, or to return to their normal positions at will. B is a small ring, with which each objective must be provided; it screws on the objective, where it may remain, and on its outer edge is a flanged groove. The objective having the ring B attached can then be slid into the "Facility Nose-piece," when about one-tenth of a turn of the milled collar on the latter causes the teeth to grip in the flanged groove B, thus securing the objective in place; the reverse movement releases the teeth from the flanged groove, when the objective will drop into the hand. This useful appliance may be obtained of Mr. Charles Coppock, 100, New Bond St., London, W.

MR. H. P. AYLWARD, of Strangeways, Manchester, has sent us a new pattern Canada-Balsam bottle. It is fitted with a tight-fitting glass cap, and is provided with a glass dipping-rod. The bottle, which is of one-ounce capacity, stands very firmly on a broad foot.

Also, his new Universal Camera Lucida. This is constructed on an entirely new principle, and will fit the eye-piece of any microscope, and can readily be adjusted to suit any power. It is provided with a good reserve supply of all shades of neutral-tint glasses.

Mr. Aylward has lately brought out a Telescope Walking-Stick to use with his Pond-Life Apparatus, which will be found a great acquisition to the students of fresh-water organisms.

Mr. W. P. COLLINS' OCTOBER CATALOGUE offers a good general selection of Scientific books, amongst which we notice many Botanical Works, from the library of the late Rev. W. A. Leighton, with several other rare and scarce works.

Microscopy as usual forms a special feature of this catalogue, and under its heading will be found a long list of Journals. Many works on Diatoms, Desmids, Algæ, Foraminifera, etc. etc.

Correspondence.

The Editors do not hold themselves responsible for the opinions or statements of their Correspondents.

To the Editor of the Journal of Microscopy aud Natural Science.

SIR,—

In the report of your last annual meeting, there are a few remarks by Mr. R. Hitchcock to the effect that in the United States of America there is an organisation in existence similar to your Society. It may be of interest to you to know that in this part of the world an attempt is being made to establish a similar organisation, only that at present it is confined to the chief cities of New South Wales, Victoria, and South Australia. We made a commencement by sending a box of objects from Melbourne to Sydney, and on its return it was accompanied by a box, the same as is used by your English society, containing 12 objects. After being examined by our Melbourne microscopists, it was sent on to Adelaide, from which city it is now returned, together with copious notes, which will be returned to our Sydney friends. It is not quite so easy to establish an organisation like this as it is to you in England, since each of the cities of Melbourne, Sydney, and Adelaide are 500 miles apart.

The organisation is at present in charge of the following members:—Mr. F. Kyngdon, Hon. Secretary of the Microscopical Section of the Royal Society of New South Wales*; Mr. H.

* Several of our members will remember Mr. Kyngdon as an old and much-valued member of the P.M.S.—ED.

Watts, one of the Vice-Presidents of the Field Naturalists' Club of Victoria; Mr. W. E. Pickels, Hon. Secretary of the Field Naturalists' Section of the Royal Society of South Australia.

I remain, Dear Sir, yours truly,

HENRY WATTS.

NEW BOOKS, ETC., RECEIVED.

"Plant Life," by Edward Step. (T. Fisher Unwin, London.)

"Desmids of the United States," by Rev. Francis Wolle. (W. P. Collins, London.)

"The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland." (Charles Griffin and Co., London.)

"The Elements of Histology," by E. Klein, M.D., F.R.S., etc. (Cassell and Co., London.)

"The Student's Guide to Systematic Botany," by Robert Bentley, F.L.S., M.R.C.S. (J. and A. Churchill, London.)

"Schmidt's Atlas of the Diatomaceæ" (photo copy), by C. Henry Kain, Camden, U.S.A.

"The Sagacity and Morality of Plants," by J. E. Taylor, Ph.D., F.L.S., etc. (Chatto and Windus, London.)

"British Wild Plants by Natural Analysis," by Frederick A. Messer. (David Bogue, London.)

"Whence? What? Where?" by James R. Nichols, M.D., A.M. (Popular Science News Co., Boston, U.S.A.)

"Popular Microscopical Studies, Studies in Microscopical Science, and Methods of Microscopical Research," by A. C. Cole.

"Geological Rambles Round London." (T. Fisher Unwin, London.)

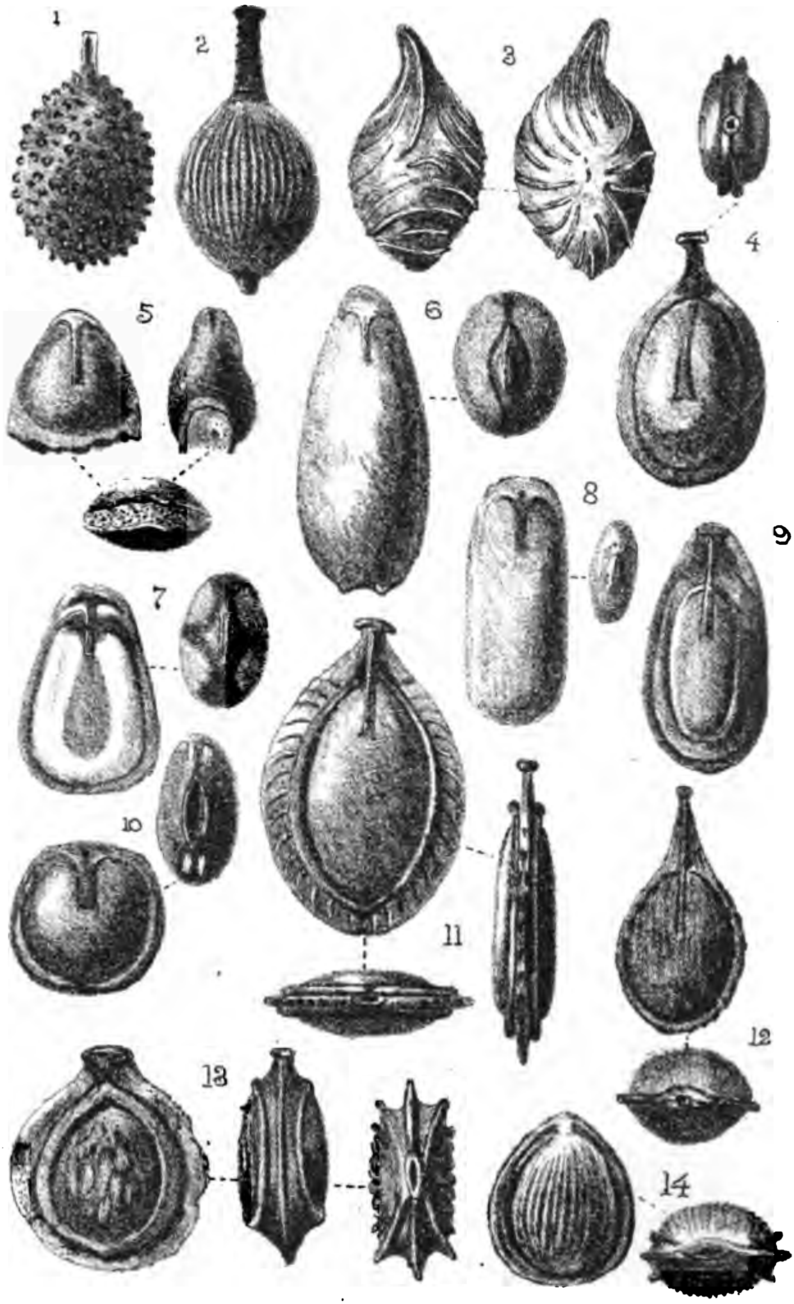
The Journal of the Royal Microscopical Society.
Science Gossip.
The Illustrated Science Monthly.
The Journal of the Quekett Microscopical Club.
The Microscopical News.
The Analyst.
The Naturalist's World.
The Natural History Journal and School Reporter.
The London Medical Record.
The Birmingham Medical Review.
The Dental Record.
The Journal of Science.
The Gentleman's Magazine.
Golden Hours.
The American Naturalist.
The American Monthly Microscopical Journal.
The Microscope.
Science Record.
Science.
Popular Science News.
The American Psychological Journal.
Van Nostrand's Engineering Magazine.
Microscopical Bulletin.
American Journal of Fabrics.
Cotton, Wool, and Iron.
Classified Catalogue of D. Appleton and Co.'s Publications, New York.
W. P. Collins's Catalogue of Books.

List of Plates.

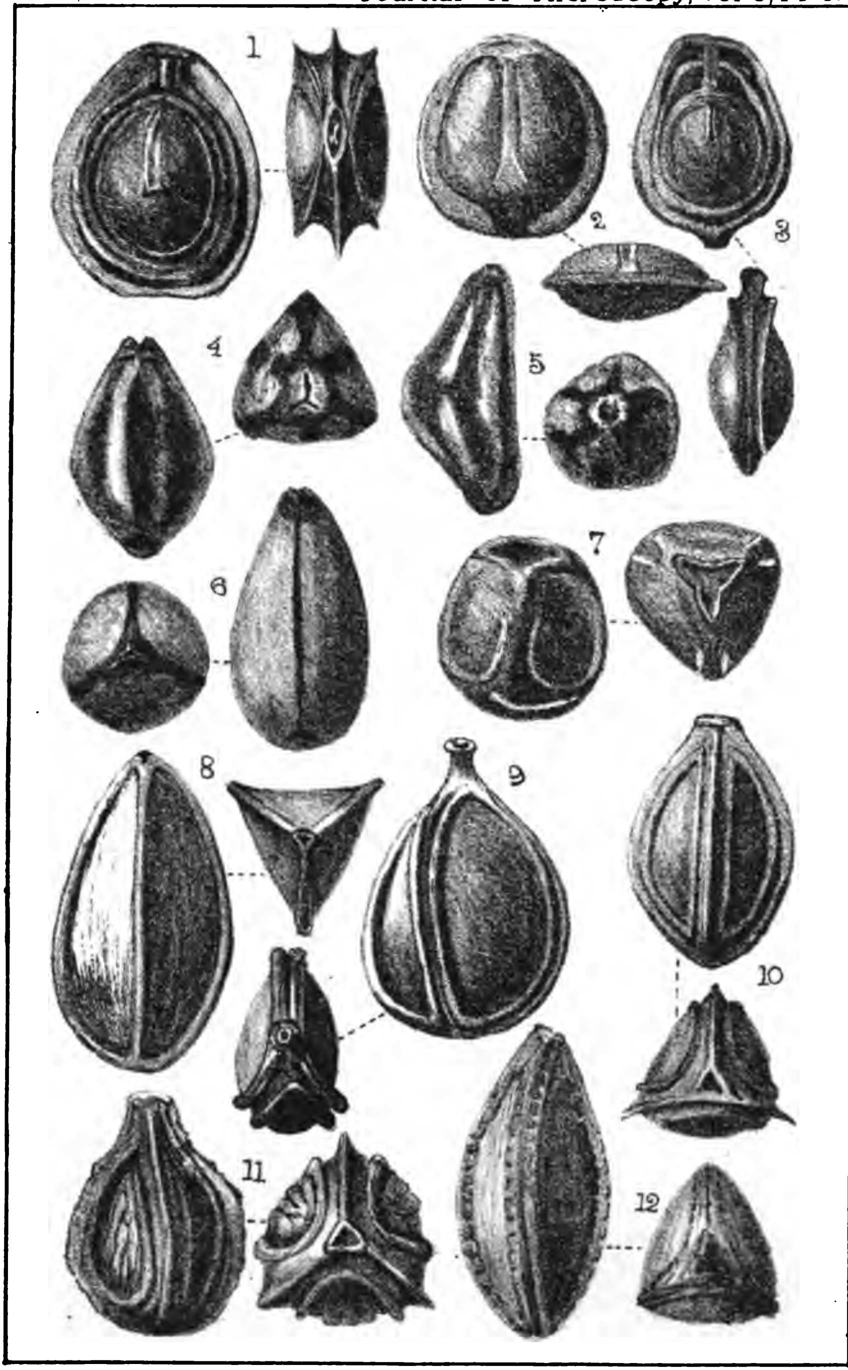
Index to Vol. III.

BATH:
CHARLES SEERS, PRINTER, ARGYLE STREET.

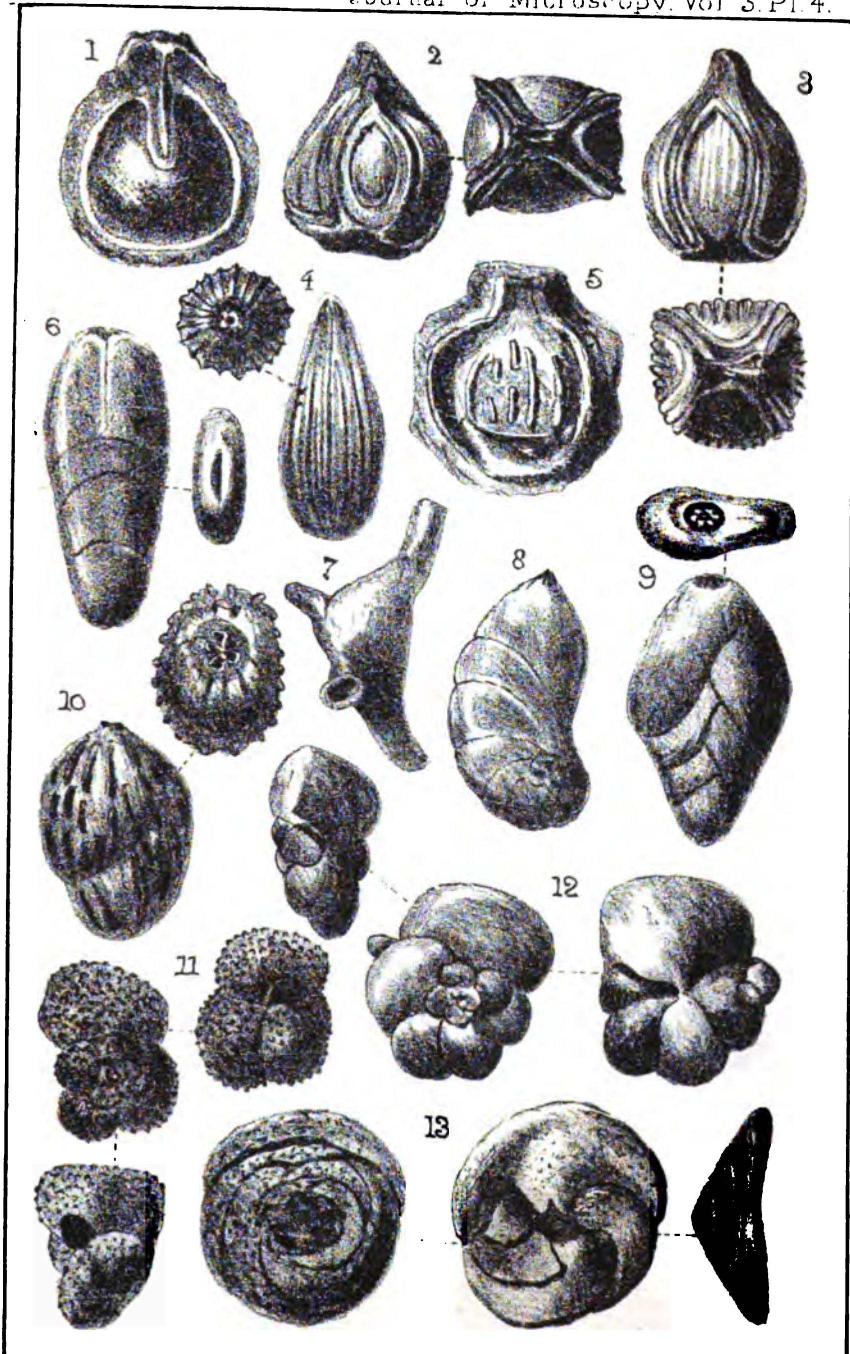
F. W. MILLETT, AD NAT DEL



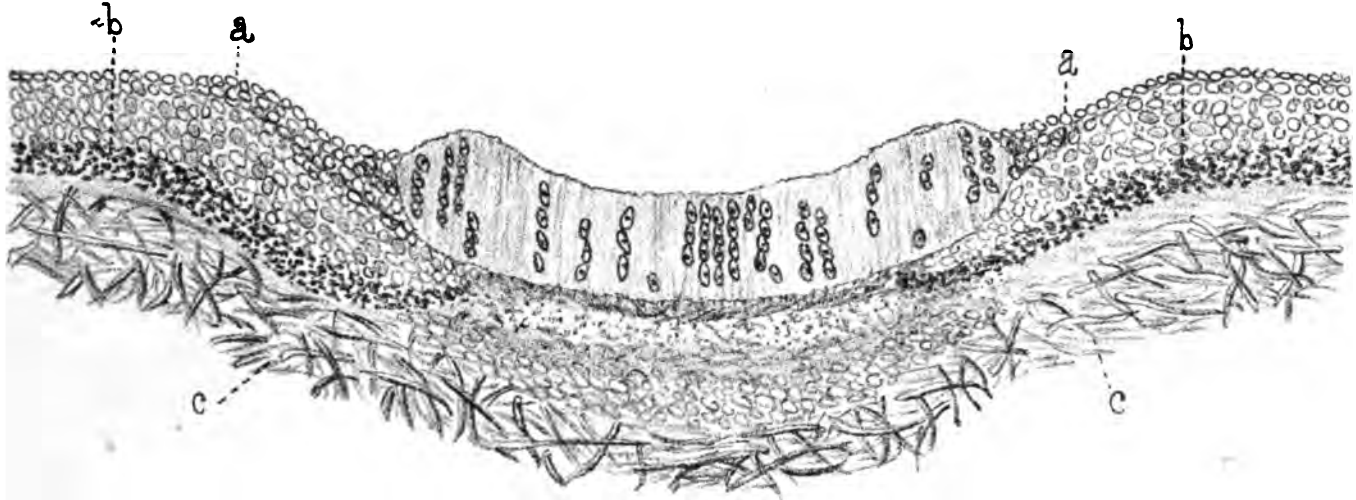
F W MILLETT, AD NAT DEL



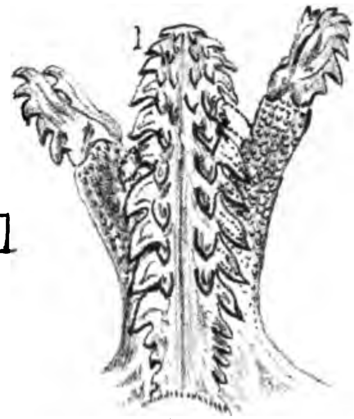
F. W. MILLETT, AD NAT DEL



F. W. MILLETT, AD NAT DEL


b
a
a
b
c
c

1



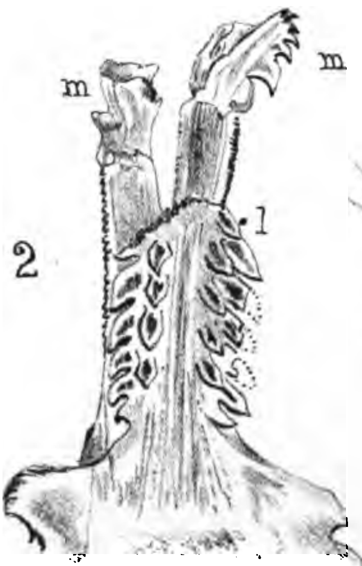
×400

3

×400

5

2

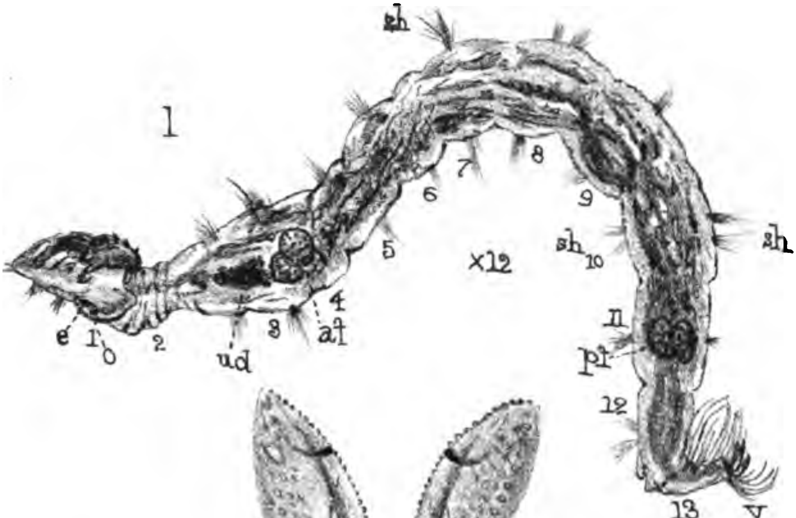


× 100

4

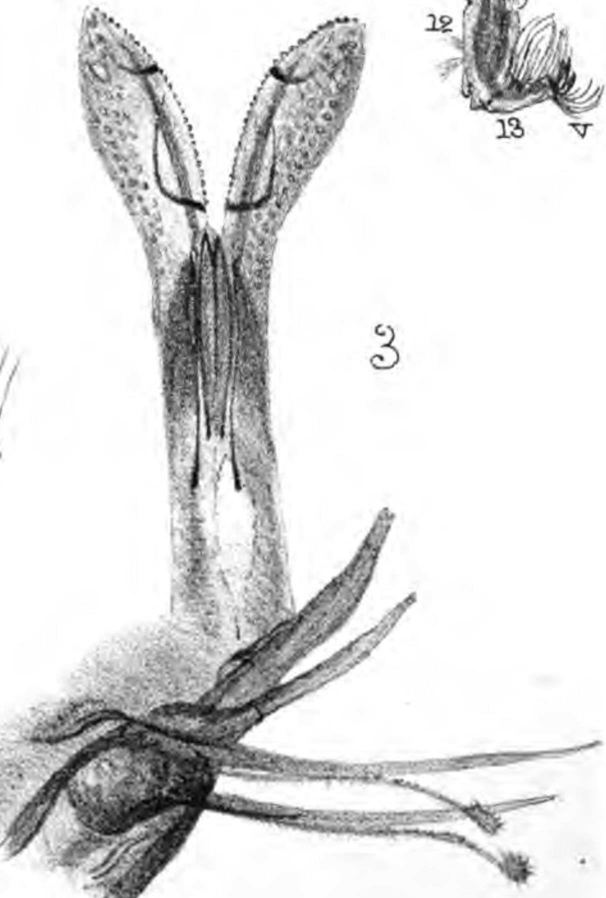
× 100

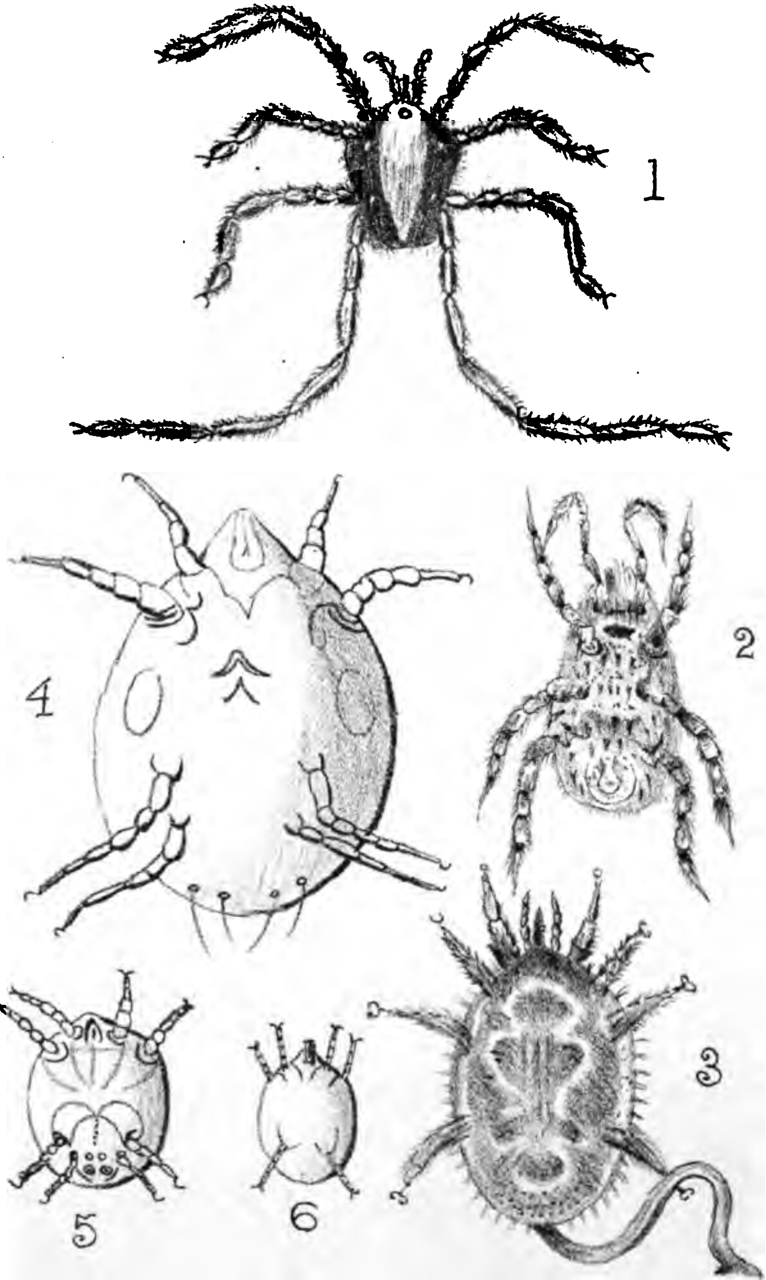
1

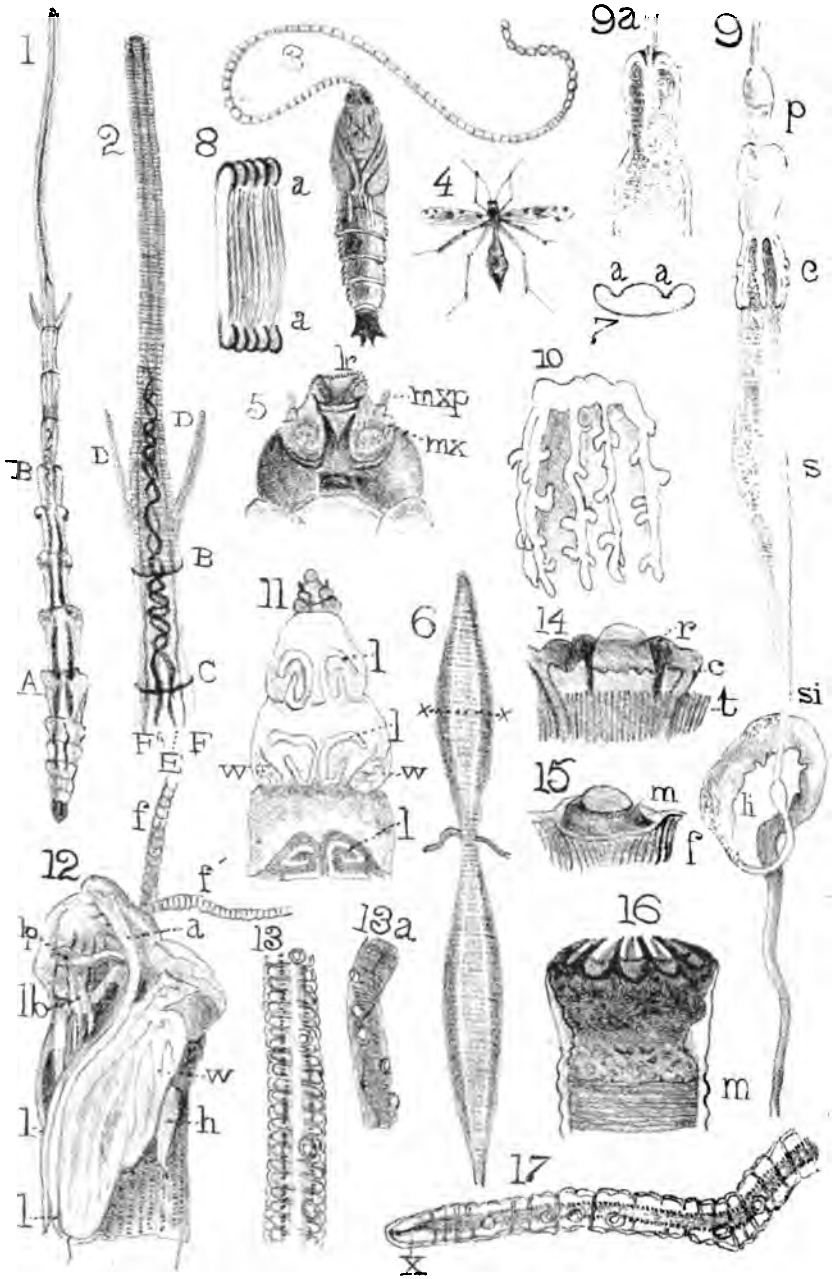


2

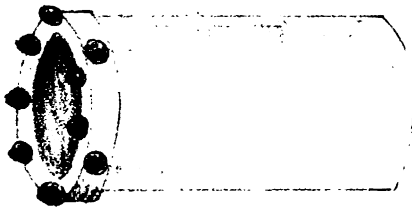
3



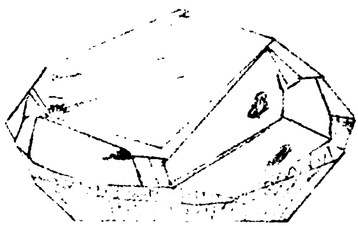




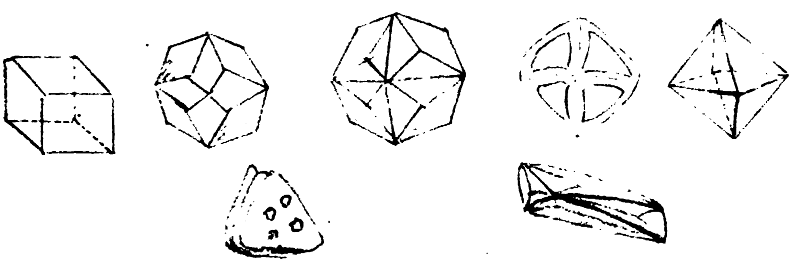
Anatomy of Psychoptera paludosa.



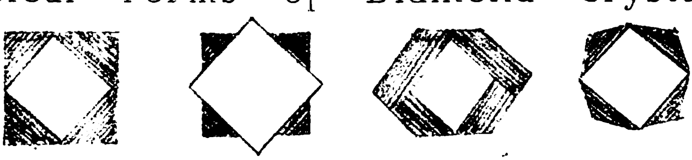
Diamond Rock-Boring Drill.



The Kohinoor before Recutting
wt., 186 cts.

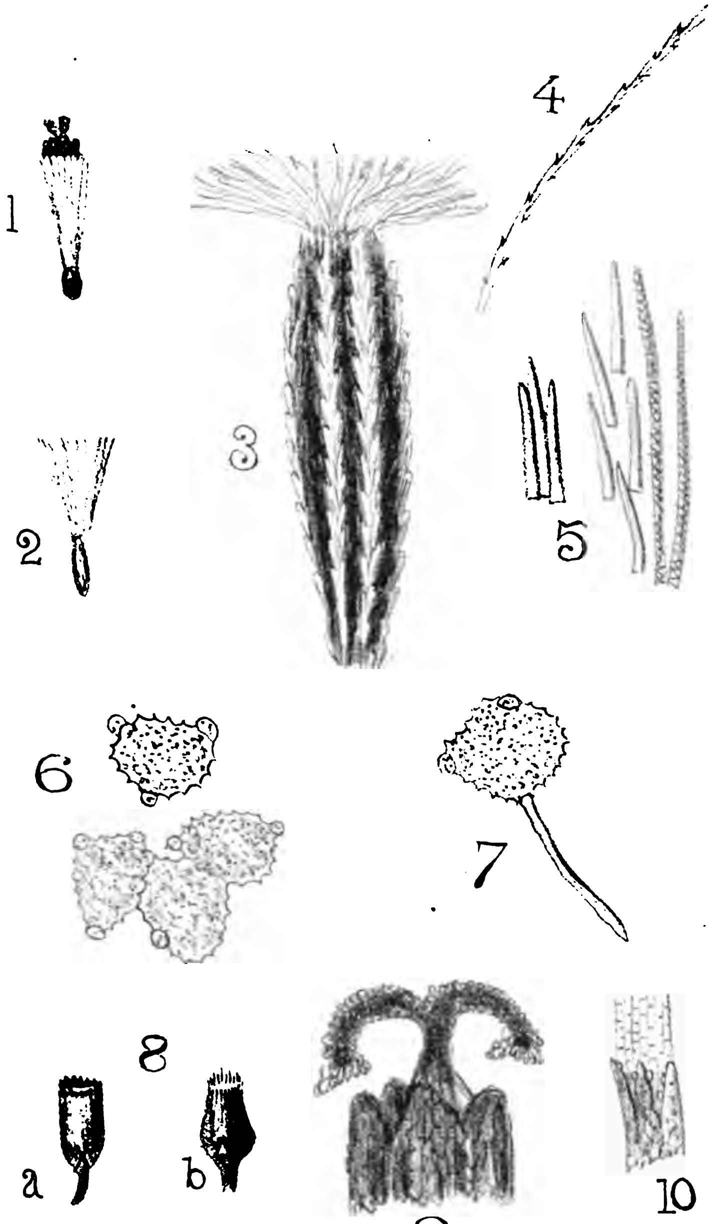


Typical Forms of Diamond Crystals.

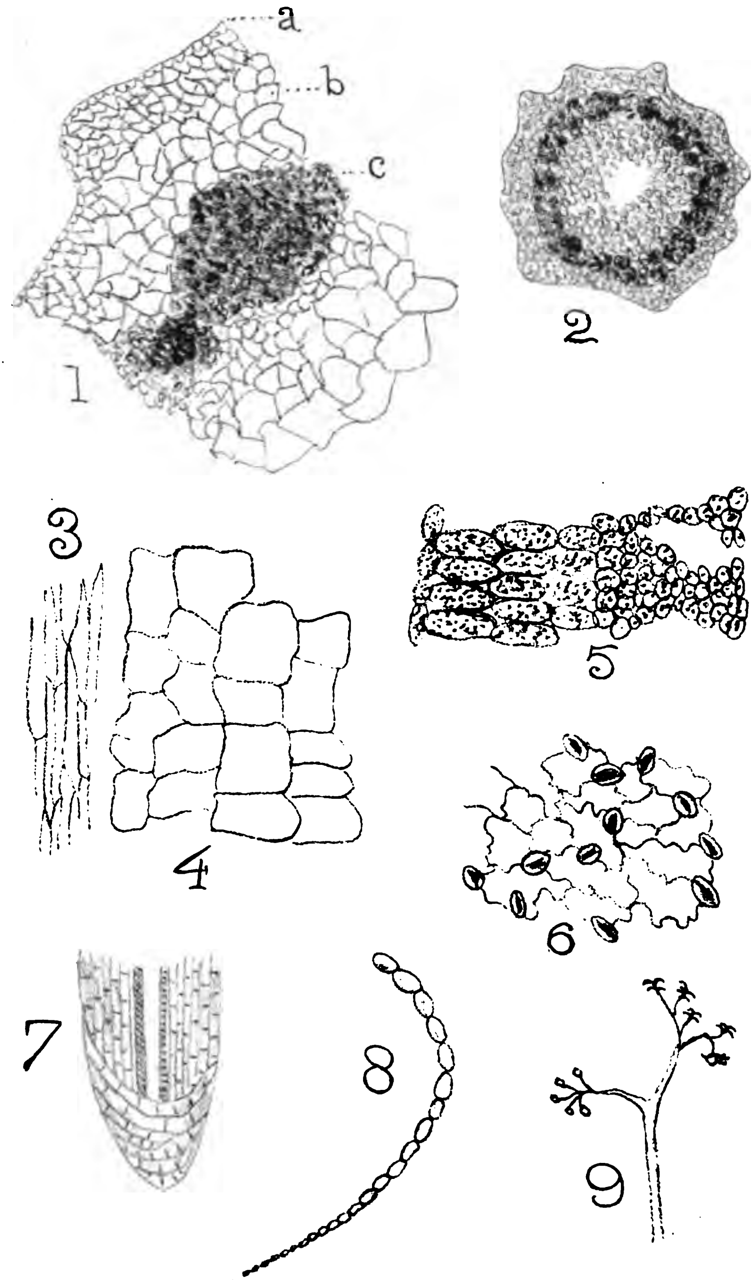


Sections indicating the
planes of Cleavage.

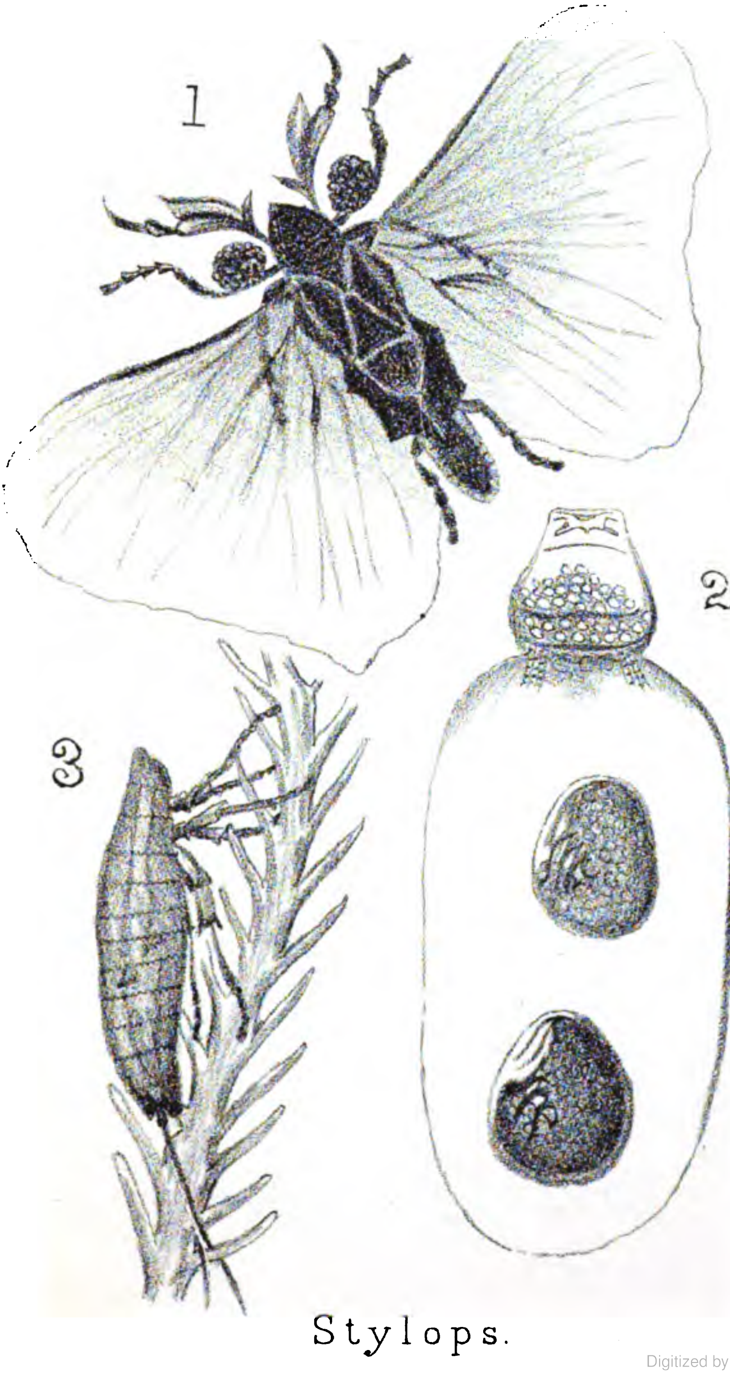
Diamonds.



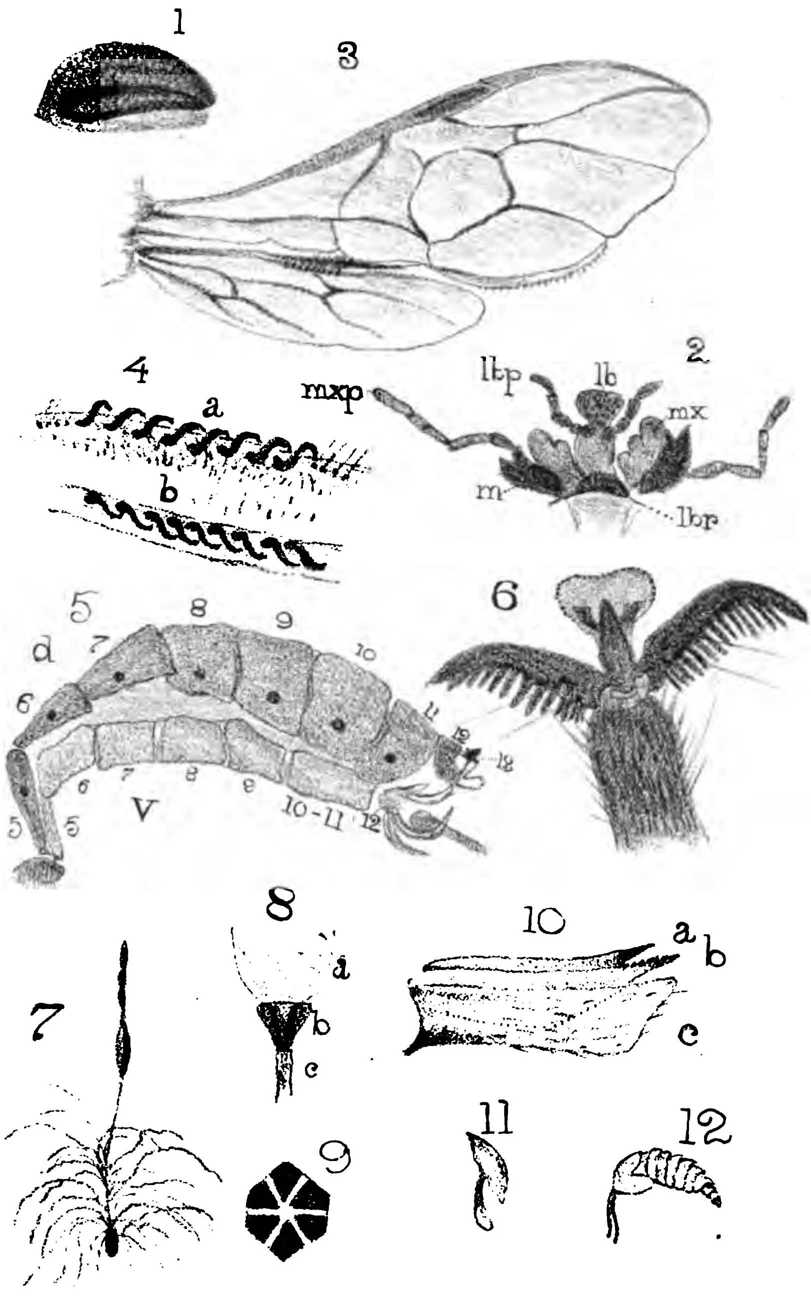
Grounusel.

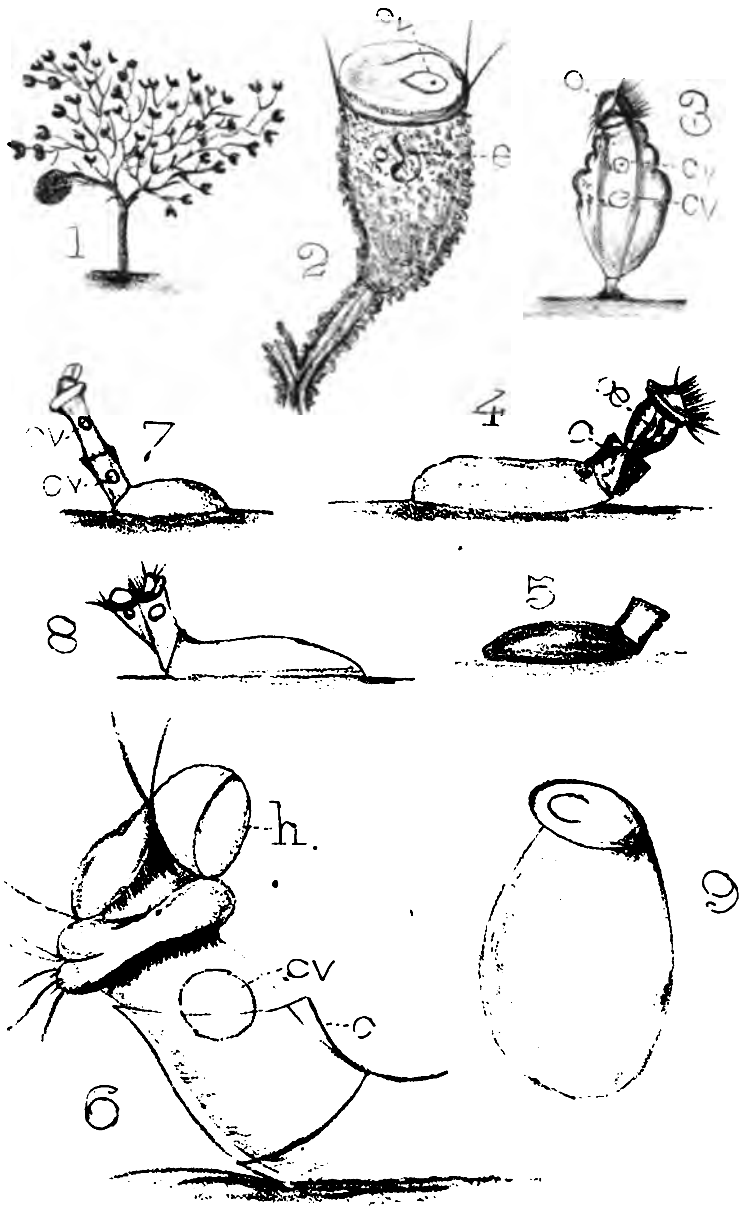


Groundsel.

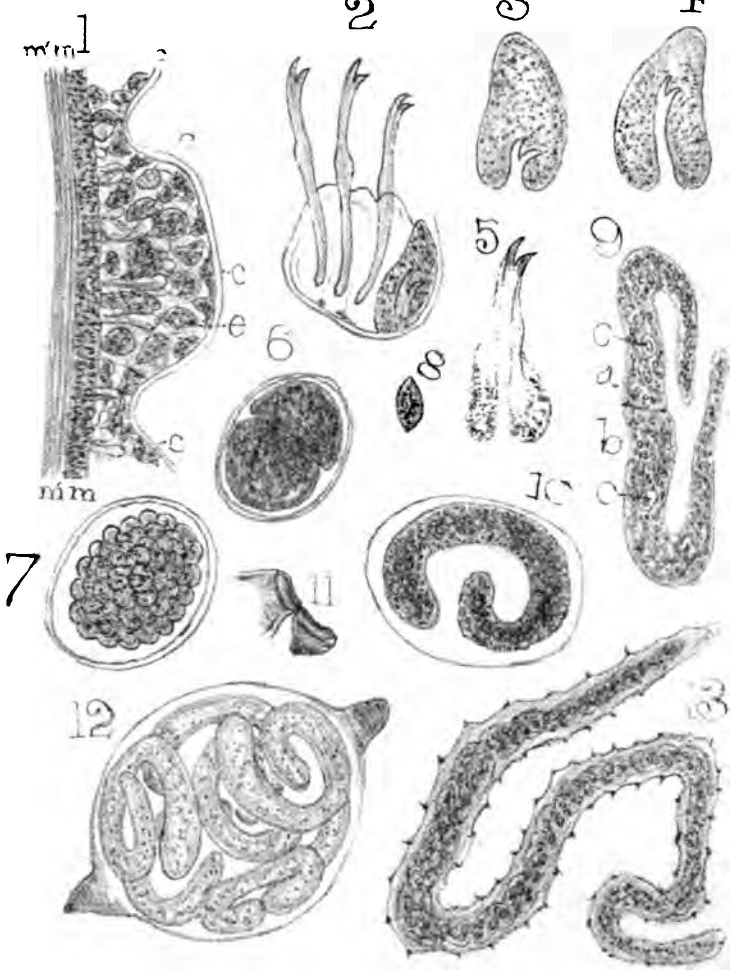


Stylops.


1
3
4
a
b
2
mxp
ltp
lb
mx
m
lbr
5
d
7
8
9
10
6
11
12
13
5
5
6
7
8
9
V
10-11
12
6
8
a
b
c
10
a
b
c
7
9
11
12

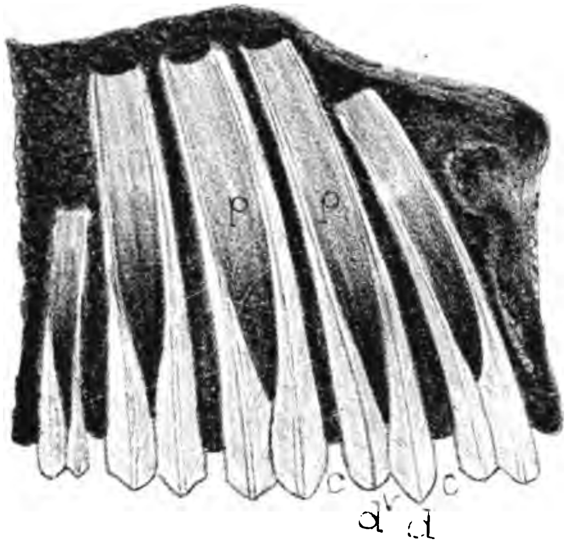


1
2
3
4
5
6
7
8
9
cv
e
o
cv
cv
cv
cv
h.
cv
c



Anatomy of Tubifex.

1

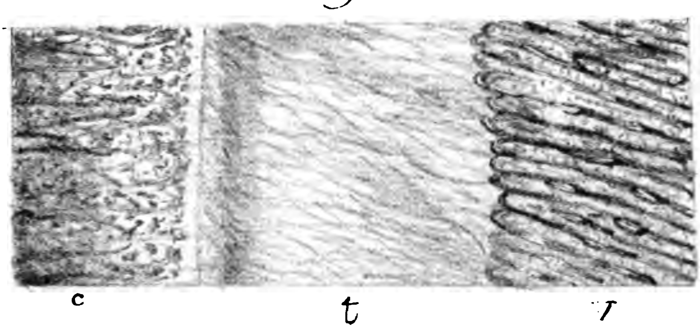


Jaw of Megatherium.

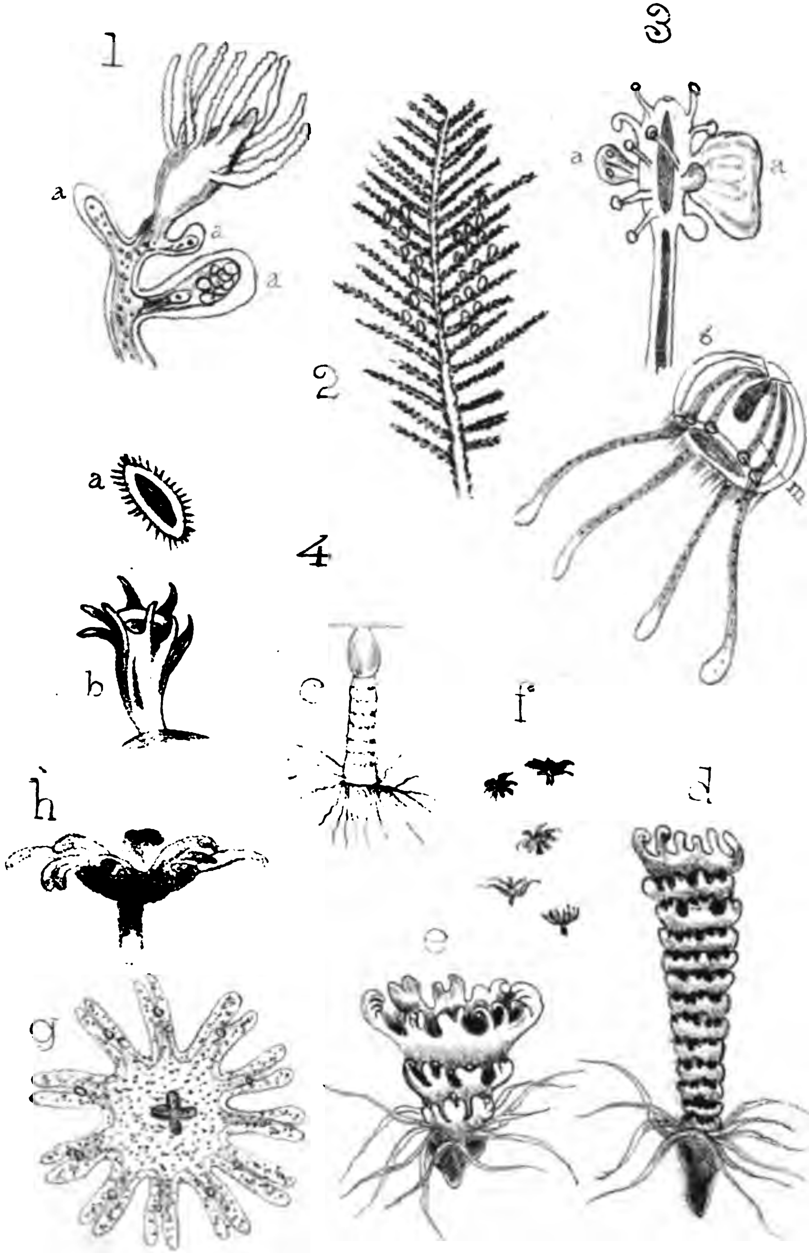
2

Teeth of Sloth.

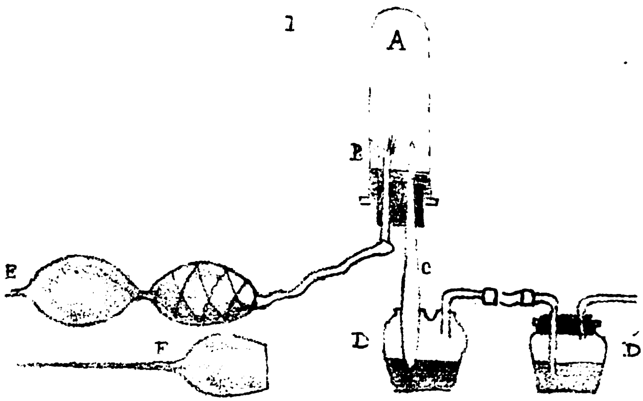
3



Portion of Tooth of Megatherium.

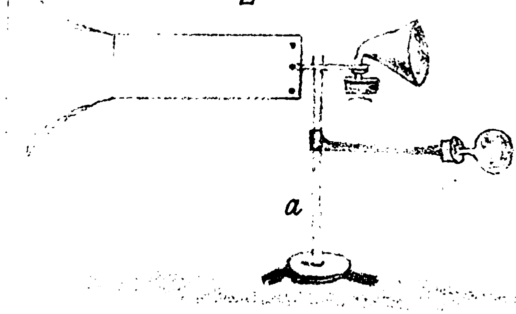

1
a
a
a
2
3
a
a
6
m
a
4
b
c
f
h
d
e
g

1

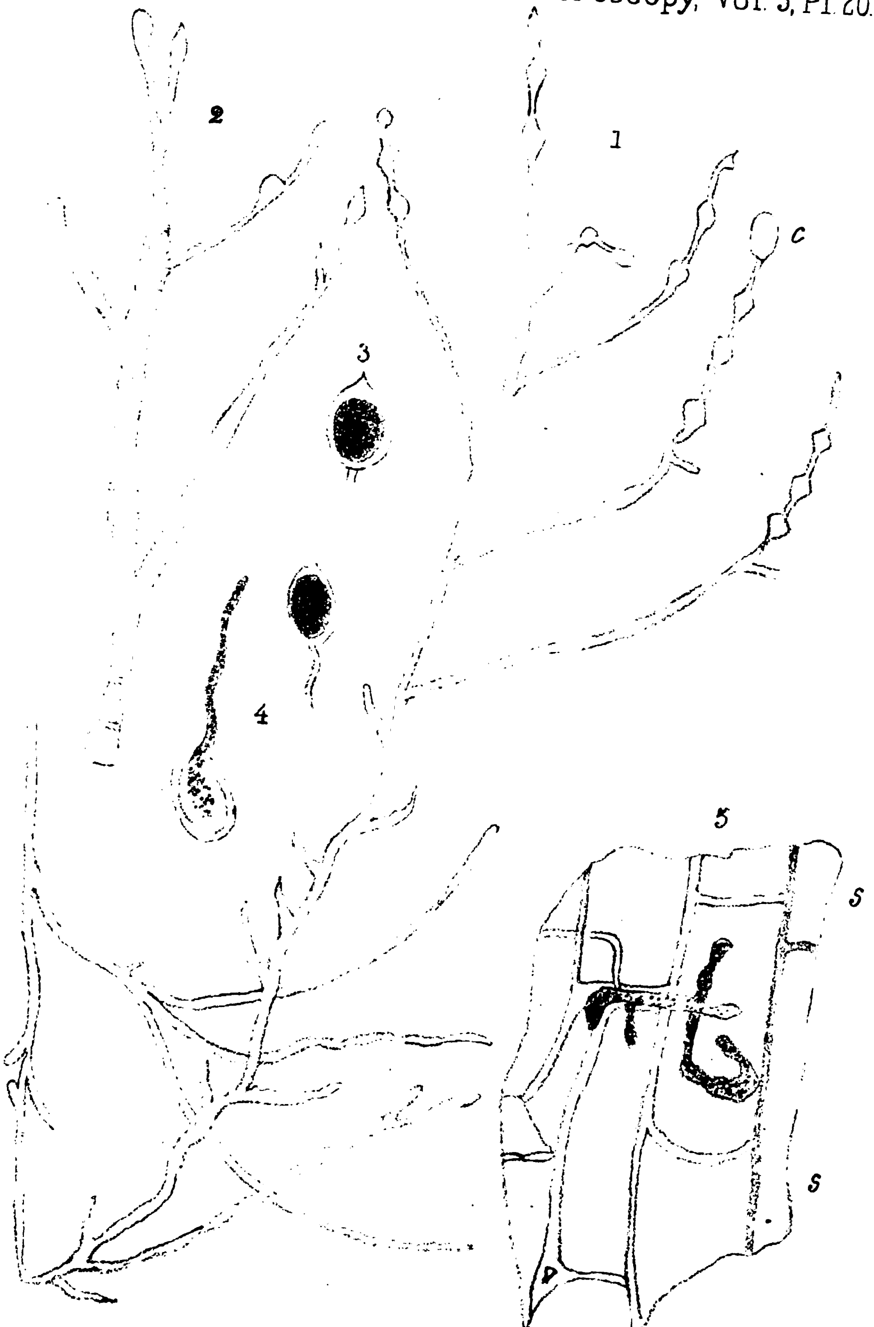


Dr. Fox's Apparatus for the Chemical Examination of the Air.

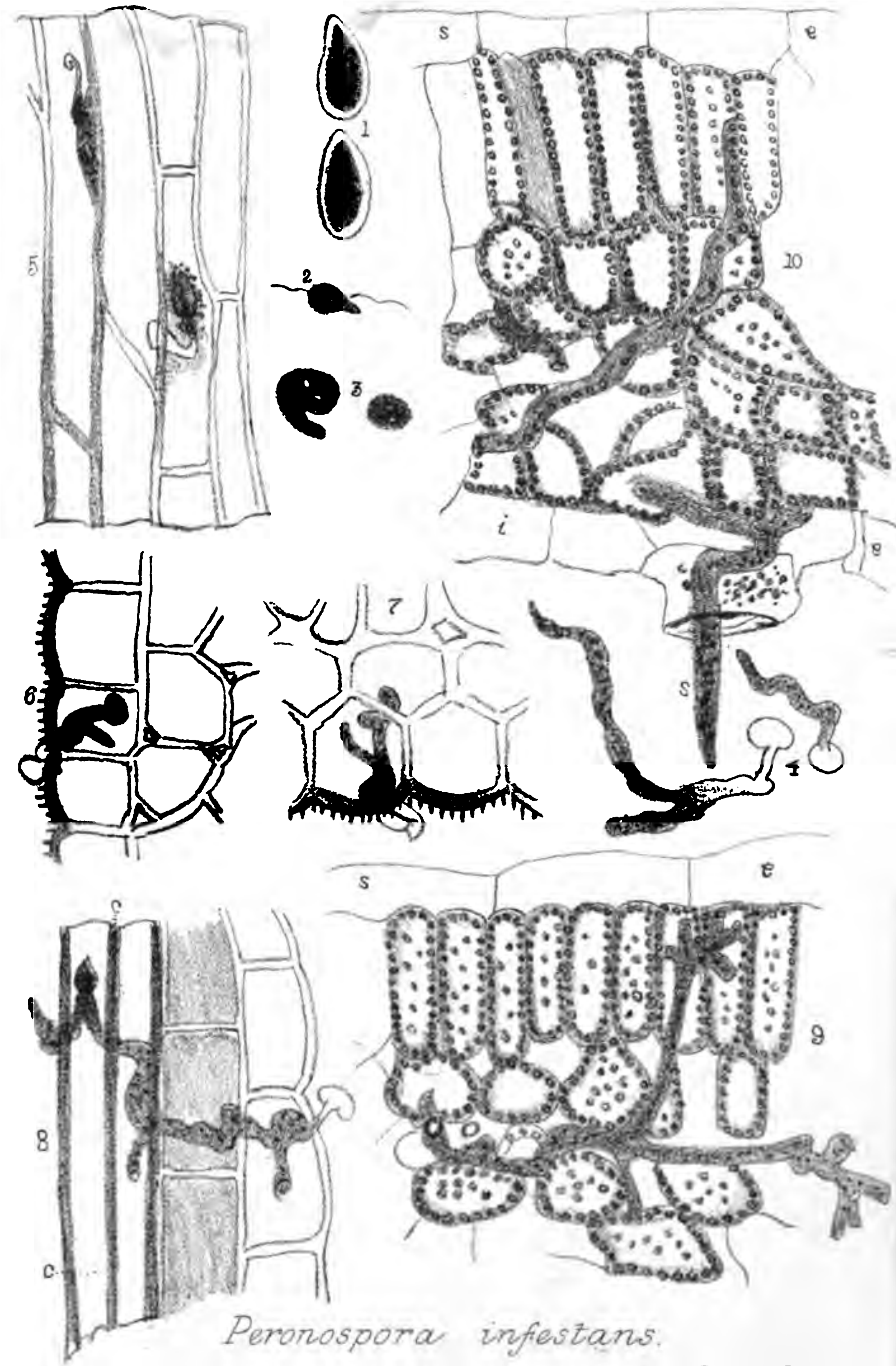
2



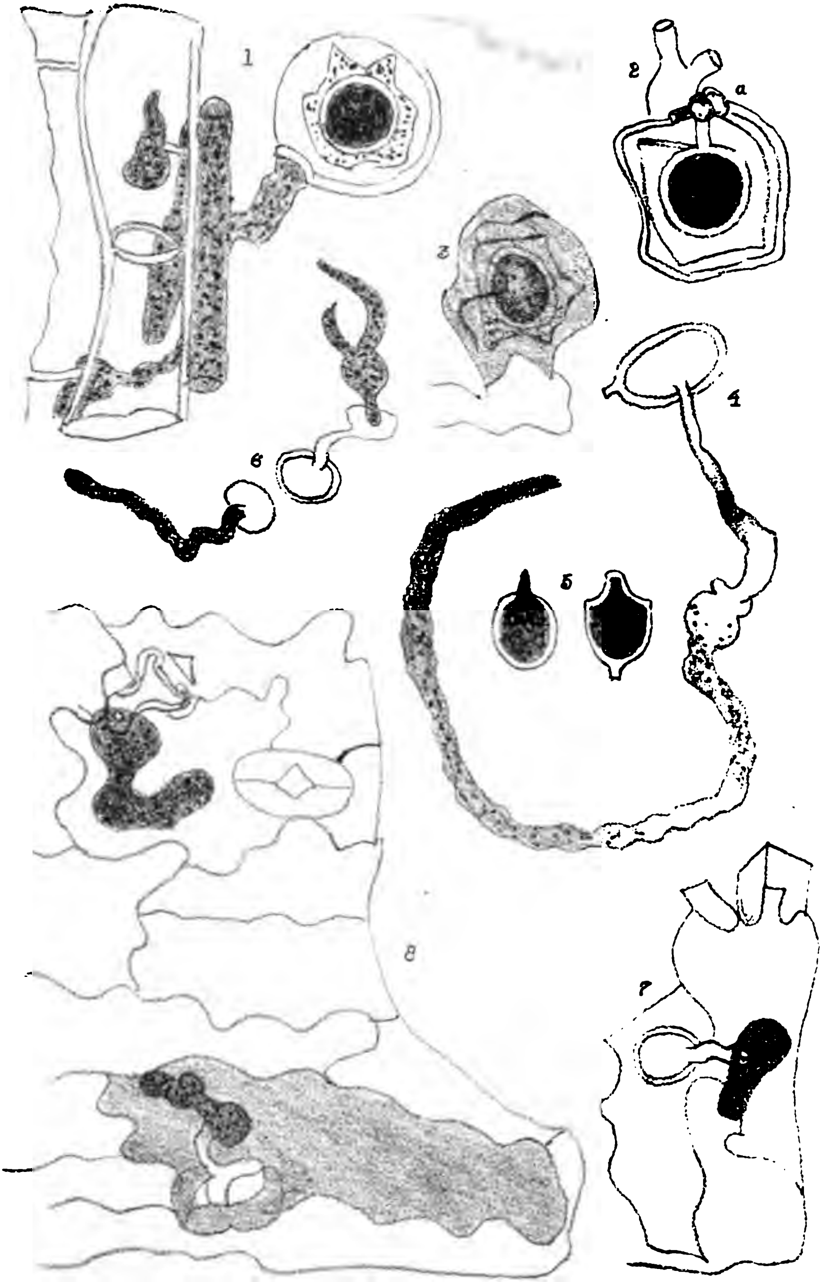
Apparatus used for the Microscopical Examination of the Air.



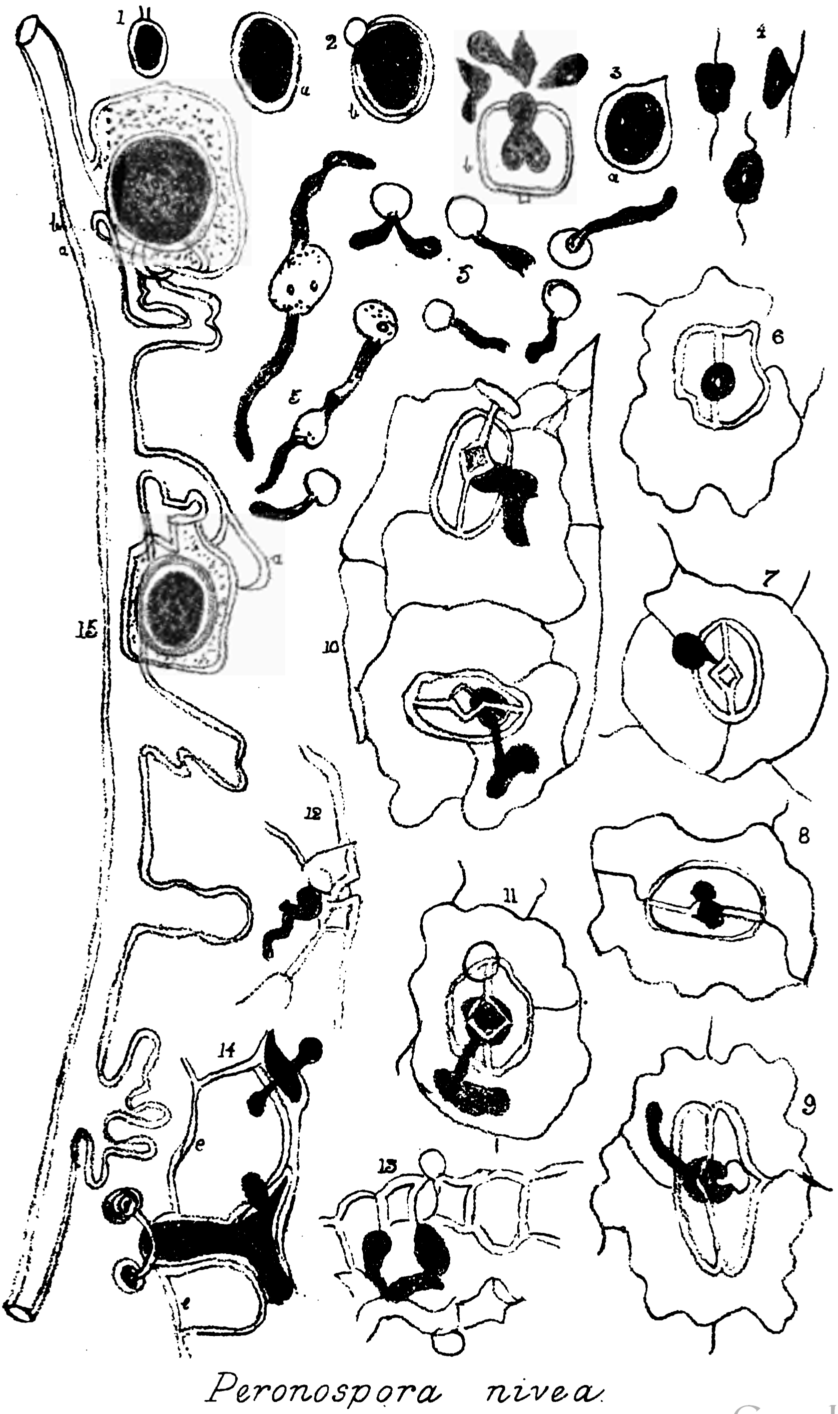
Peronospora infestans.



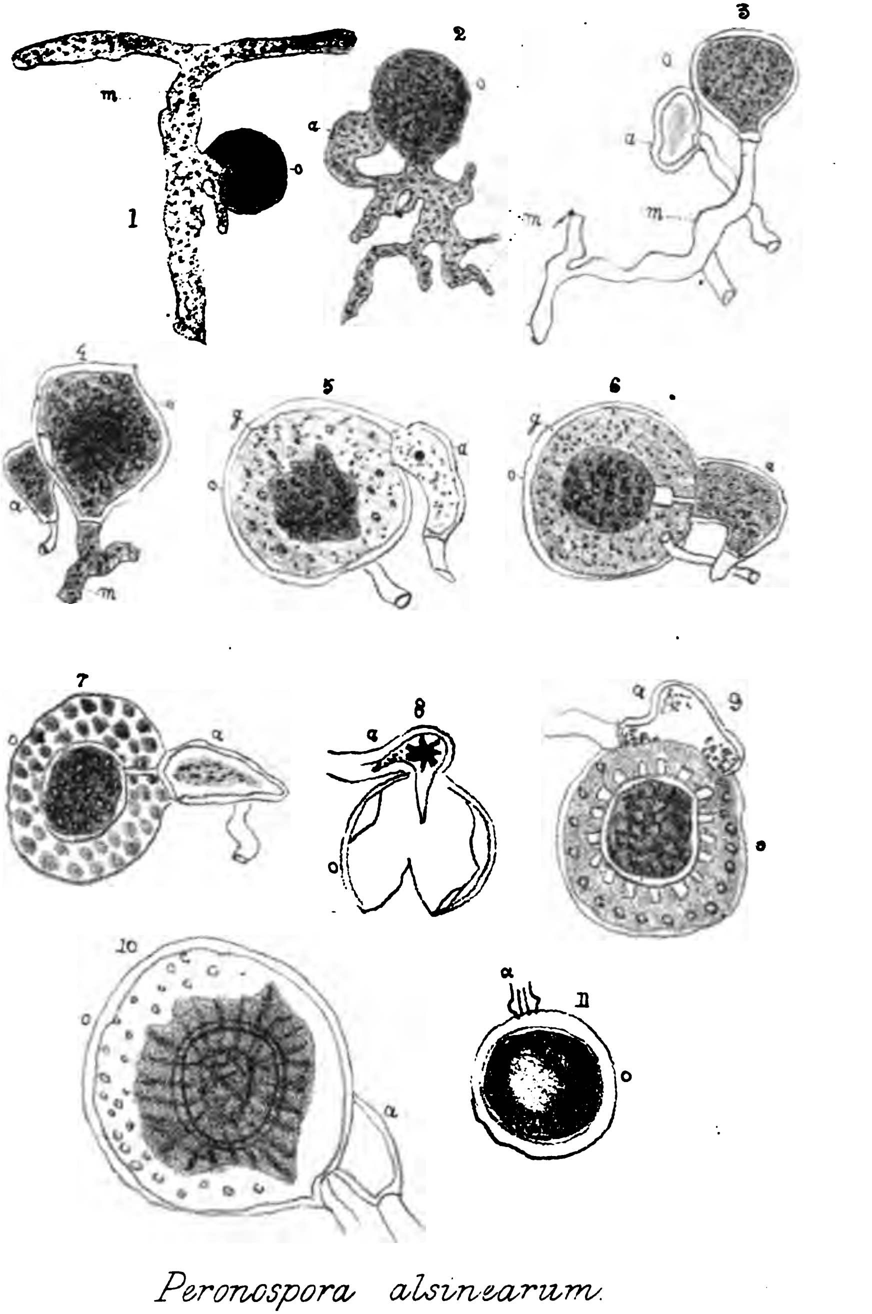
Peronospora infestans.



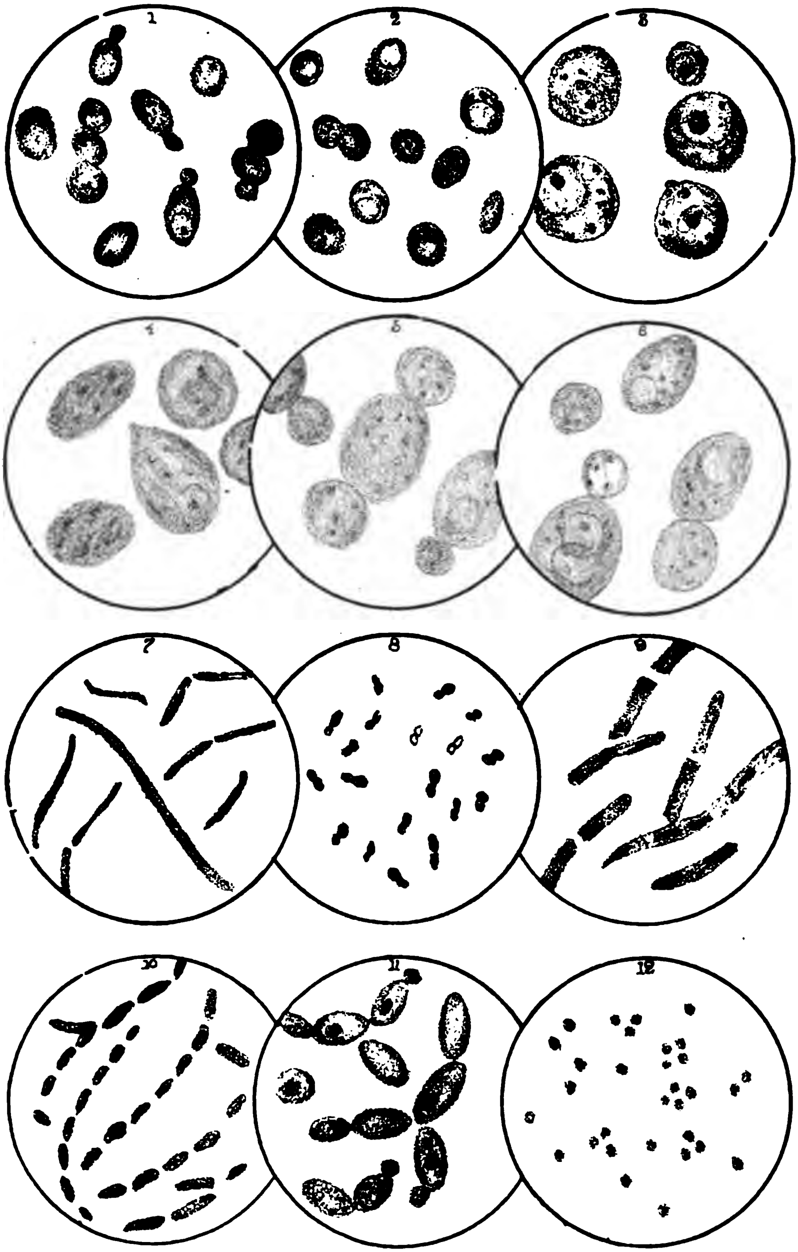
Peronospora parasitica and ganglioniformis.



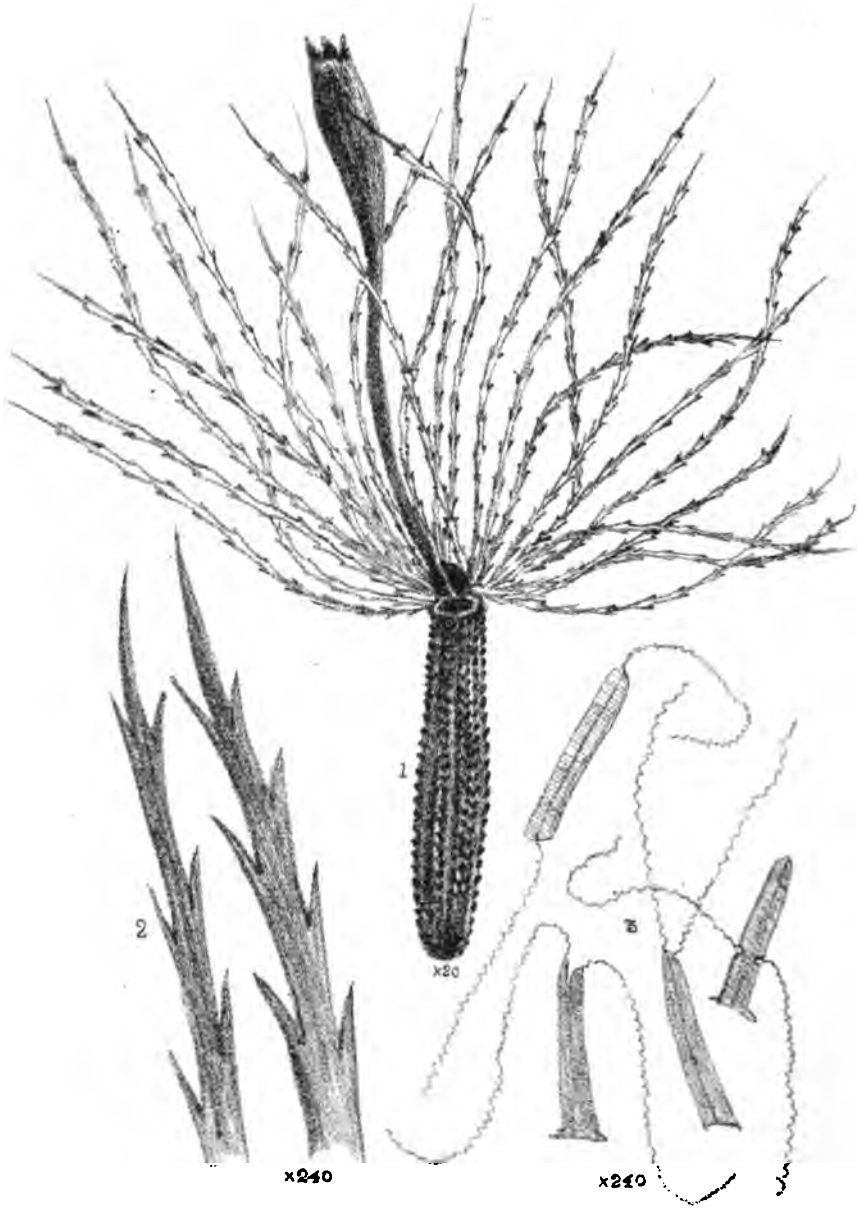
Peronospora nivea.



Peronospora alsinearum.

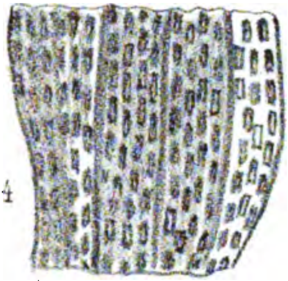


Yeast, &c.



Senecio vulgaris

4



×54

7

×240

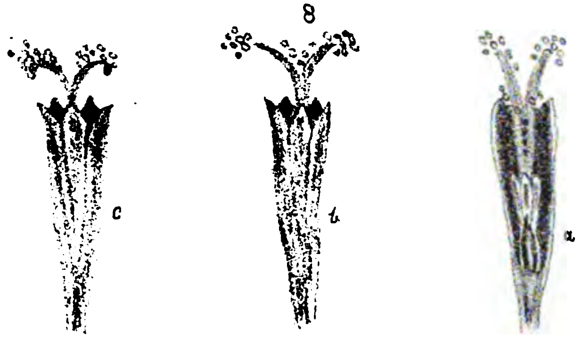
5

×50

6

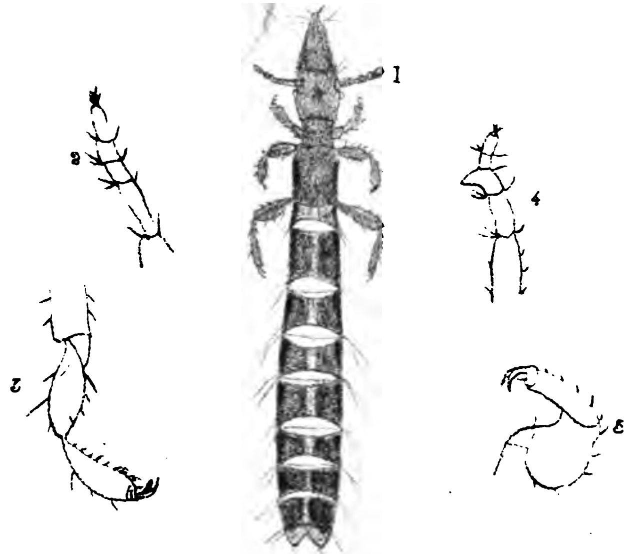
×240

8

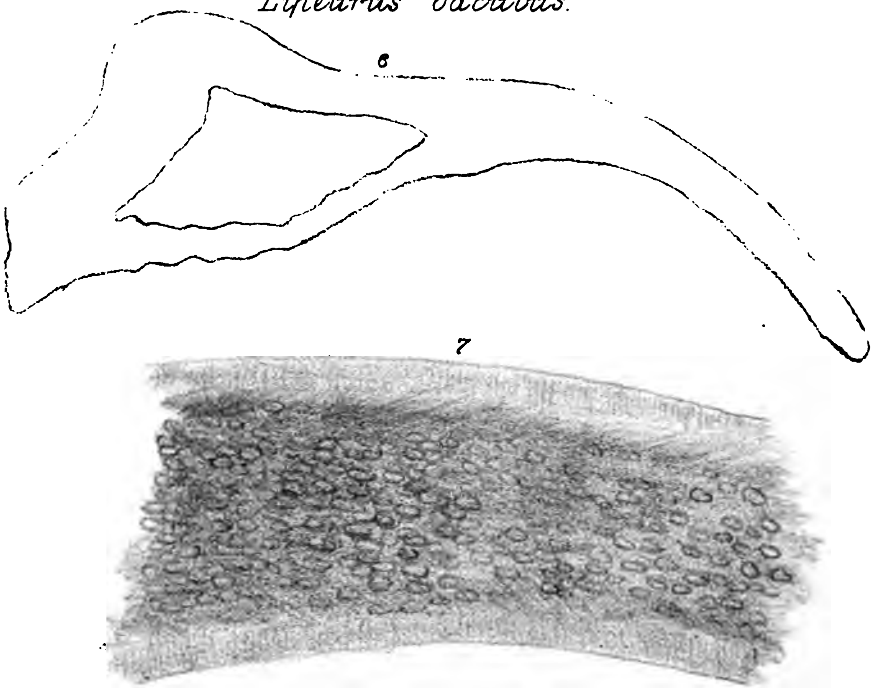


×12

Senecio vulgaris



Lipeurus baculus.



Fang of Viper.

3

Vol. 3.] APRIL, 1884. [Part 10.

THE JOURNAL OF MICROSCOPY AND NATURAL SCIENCE:

THE JOURNAL OF The Postal Microscopical Society.

PUBLISHED QUARTERLY.

"Knowledge is not given us to keep, but to impart: its worth is lost in concealment."

EDITED BY

ALFRED ALLEN,

HONORARY SECRETARY OF THE POSTAL MICROSCOPICAL SOCIETY;

ASSISTED BY

SEVERAL MEMBERS OF THE COMMITTEE.

LONDON:
W. P. COLLINS, 157, GREAT PORTLAND STREET, W.

BATH:
1, CAMBRIDGE PLACE

C. SEERS, PRINTER, 1, ARGYLE STREET, BATH.

Price One Shilling and Sixpence.

CONTENTS.

OSTEOLOGY.

Skeleton of Frog, as supplied to the leading Professors of Biology, carefully mounted, 3/9, post paid.

A SELECTION OF SKELETONS SENT ON APPROVAL.

Science Classes Supplied with all Specimens at Reduced Prices.

APPLY—

WILTON'S BIOLOGICAL VIVARIUM,

NORTHFIELD VILLAS, LEEDS.

E. MARLOW, CONSTITUTION HILL, BIRMINGHAM,

MANUFACTURER OF

Every description of Microscopical Glass.

Sole Maker of the Registered "Microscopist's Compendium."

PREPARER OF ALL KINDS OF MOUNTING MEDIA.

Manufacturer of Turn-Tables, Slide-Boxes, Cabinets, etc.

Glass Aquariums and Zoophyte-Troughs. Metal Cells (round & square), etc.

AGENT FOR THE SALE OF A. C. COLE'S MICROSCOPICAL SPECIALITIES.

A LARGE ASSORTMENT OF

Botanical, Histological, and Petrological Slides kept in stock.

Plain & Ornamental Adhesive Labels. List of prices on application.

Dealers and Shippers supplied on favourable terms.

EDWARD WARD'S BROWN CEMENT

Price 1/-; Post Free, 1/3.

E. W. desires to call attention to the fact that "Brown Cement" is his original discovery, and was FIRST referred to in a paper read before the Manchester Science Association, on Jan. 26, 1880. Its success has been so great that the name has been copied, and numerous imitations have been advertised and sold; but Microscopists, when purchasing at a dealer's, should insist on having the original cement, which at present is unsurpassed. EVERY REQUISITE FOR MICRO WORK.

EDWARD WARD, 249, OXFORD STREET, MANCHESTER.

AYLWARD'S UNIVERSAL CAMERA-LUCIDA, to fit the eye-piece of any Microscope, 3/9, Post Free.

AYLWARD'S CANADA-BALSAM BOTTLE, fitted with glass rod, 1/-.

AYLWARD'S TELESCOPE WALKING-STICK, to use with Pond-Life Collecting Apparatus, 5/-.

H. P. AYLWARD,

15, COTHAM STREET, STRANGEWAYS, MANCHESTER.

CHAS. COLLINS,

MICROSCOPE MAKER.

HISTOLOGICAL MICROSCOPE,

With 1-inch and ¼-inch Objectives of splendid definition, complete, in Mahogany Case, £5 10s.

HARLEY Binocular Microscopes, Dissecting Microscopes, Cabinets, Objects, Lamps, Object-Glasses, Thin Glass, Ground Slips, Pocket Magnifiers, Mounting Media, etc.

36-page Catalogue free.

157, Gt. Portland St., London, W.

W. P. COLLINS,

Microscopical & Natural Science BOOKSELLER.

New and Second-hand Works on Algæ, Biology, Botany, Chemistry, Corals, Conchology, Desmids, Diatoms, Entomology, Fossils, Geology, Histology, Infusoria, Microscopy, Mineralogy, Natural History, etc. Back parts of the various Microscopical Journals always in stock. New Catalogue, just ready, will be sent on application.

Microscopical Books bought or exchanged.

157, Gt. Portland St., Oxford St.,

London (corner of Weymouth St.).

THE POSTAL
MICROSCOPICAL SOCIETY

PRESIDENT:

CAREY P. COOMBS, M.D. Lon., Castle Cary.

HON. SECRETARY:

A. ALLEN, 1, Cambridge Place, Bath.

THE SOCIETY was formed in 1873 to aid in the study, discussion, and circulation of Microscopic objects, and to advance the pursuit of Natural Science among its members.

It is divided into thirteen Circuits of about twelve members each, arranged geographically. A box of Slides, accompanied by MS. book for the insertion of Notes and Memoranda, is sent by the Hon. Secretary, at fortnightly intervals, to the first member on one of the Circuits; who, after keeping it for three days, must send it on by post to the next on the list, and he to the following one. When it has gone round the Circuit, the last member returns it to the Hon. Secretary, who will then forward it to the first member of the next Circuit, and so on, until the slides have been seen by the whole of the Society. Each member is expected to contribute six Slides annually, which are returned to him after they have been round the Circuits. Ladies, as well as gentlemen, may be elected members of the Society.

Entrance fee, Five Shillings; Annual Subscription, Ten Shillings; dating from 1st October in each year.

A copy of the Journal is posted to each member on day of publication free.

All communications on matters connected with the Society, or with this Journal, should be addressed to the Hon. Secretary, as above.

THE POSTAL MICROSCOPICAL SOCIETY

PRESIDENT:
CAREY P. COOMBS, M.D. Lon., Castle Cary.

HON. SECRETARY:
A. ALLEN, 1, Cambridge Place, Bath.

THE SOCIETY was formed in 1873 to aid in the study, discussion, and circulation of Microscopic objects, and to advance the pursuit of Natural Science among its members.

It is divided into thirteen Circuits of about twelve members each, arranged geographically. A box of Slides, accompanied by MS. book for the insertion of Notes and Memoranda, is sent by the Hon. Secretary, at fortnightly intervals to the first member on one of the Circuits; who, after keeping it for three days, must send it on by post to the next on the list, and he to the following one. When it has gone round the Circuit, the last member returns it to the Hon. Secretary, who will then forward it to the first member of the next Circuit, and so on, until the slides have been seen by the whole of the Society. Each member is expected to contribute six Slides annually, which are returned to him after they have been round the Circuits. Ladies, as well as gentlemen, may be elected members of the Society.

A special section has lately been formed for members of the Medical Profession.

Entrance fee, Five Shillings; Annual Subscription, Ten Shillings; dating from 1st October in each year.

A copy of the Journal is posted to each member on day of publication free.

All communications on matters connected with the Society, or with this Journal, should be addressed to the Hon. Secretary, as above.

Natural History, Microscopical, and General Science.

The largest Collection of Second-hand Works

RELATING TO THE ABOVE

TO BE HAD OF

JOHN WHELDON, 58, Gt. Queen Street, London, W.C.

PRICE 12s.

THE "CONCENTRIC."

(Registered.) A new self-centering **Turn Table**, acknowledged to be the best yet introduced, designed and manufactured by **H. P. AYLWARD,**

Dealer in Microscopes, Apparatus, and all kinds of Microscopical Material,

15, Cotham Street, Strangeways, Manchester.

Aylward's Working Microscope. (For Review see the *Northern Microscopist*, August, 1881). The original form, which has been most highly praised, has recently been much improved by Mr. Aylward.

Aylward's Mounting Case contains every requisite portably packed.

Microscopical Specimens by all the best preparers; unmounted material of all kinds.

Special notice is directed to the **NEW POND-LIFE COLLECTING APPARATUS,** which has been so favourably noticed in the leading Microscopical and Scientific Journals, and highly recommended by all who have used them. They are generally admitted to be the best introduced. Designed and manufactured by H. P. AYLWARD.

Mr. Aylward has devoted special attention to the production of **thin cover glasses,** and supplies them in **squares, circles, and ovals. Microscopical slips with ground edges,** etc. Special quotations to the Trade and Shippers.

NOW ENLARGED TO TWENTY PAGES.

THE NATURALIST'S WORLD,

ILLUSTRATED. PRICE TWOPENCE, MONTHLY.

"This is a grand effort to popularise Science. . . . If you want to know a butterfly or a bird, to identify a fossil or a plant, get this little magazine. You won't begrudge Twopence for it."—Kettering Observer.

SUMMARY OF PRINCIPAL CONTENTS.

NOTES AND QUERIES, SALE AND EXCHANGE COLUMN, LETTER BOX, CLUB NEWS, EDITOR'S GOSSIP, ETC. ETC.

"The Cheapest Serial of the kind we have seen."—Cumberland Pacquet.

Specimen copy sent post free for 2½d. in stamps. Yearly Subscription. 2/6, post free.

OFFICES: ILKLEY, YORKSHIRE.

London: W. Swan Sonnenschein and Co., Paternoster Square.

Manchester: John Heywood. Glasgow: Porteous Brothers.

Edinburgh: Machlachlan and Stewart.

12

K 2